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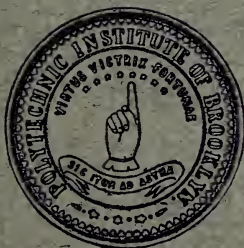
The Institute



POLYTECHNIC

INSTITUTE OF BROOKLYN

College of Arts and Engineering



1907-1908

FIFTY=SECOND

ANNUAL CATALOGUE

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College of Arts and Engineering

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ANNUAL CATALOGUE

1907

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College Calendar

1907

Summer Examinations for Admission	{ Monday,	June 10
	{ Tuesday,	June 11
Commencement	Wednesday,	June 12
Summer School Survey	{ Friday,	June 14
	{ Friday,	June 28

SUMMER VACATION—FOURTEEN WEEKS

First Semester Begins	Wednesday,	Sept. 18
Fall Examinations for Admission and of Students Conditioned	{ Wednesday,	Sept. 18
	{ Thursday	Sept. 19
	{ Friday,	Sept. 20
Regular Sessions Open	Monday,	Sept. 23
Meeting of the Corporation	Thursday,	Sept. 26
Annual Meeting of the Corporation	Thursday,	Oct. 24
Election Day—Holiday	Tuesday,	Nov. 5
Meeting of the Corporation	Thursday,	Nov. 21
Thanksgiving Recess	{ Thursday.	Nov. 28
	{ Friday,	Nov. 29
Winter Vacation Begins	Saturday,	Dec. 21

WINTER VACATION—TEN DAYS

1908

Winter Session Resumed	Thursday,	Jan. 2
Meeting of the Corporation	Thursday,	Jan. 23
Winter Examinations Begin	Monday,	Feb. 3
Winter Examinations for Admission	{ Monday,	Feb. 3
	{ to Monday,	Feb. 10
Second Semester Begins	Monday,	Feb. 10
Lincoln's Birthday—Holiday	Wednesday,	Feb. 12
Washington's Birthday—Holiday	Saturday,	Feb. 22
Meeting of the Corporation	Thursday,	Feb. 27
Meeting of the Corporation	Thursday,	Mar. 26

SPRING VACATION—ONE WEEK

Spring Vacation Begins	Monday,	Apl. 13
Sessions Resumed	Monday,	Apl. 20
Meeting of the Corporation	Thursday,	Apl. 23
Meeting of the Corporation	Thursday,	May 21
Memorial Day—Holiday	Saturday,	May 30
Last Day for Presentation of Theses	Monday	June 1
Summer Examinations Begin	Monday,	June 1
Examination Announcements	Monday,	June 8
Summer Examinations for Admission	{ Monday,	June 8
	{ Tuesday,	June 9
	{ Wednesday,	June 10
Commencement	Wednesday,	June 10

Office Hours.

THE PRESIDENT is in his office, in the College of Arts and Engineering Building, daily, during sessions, from 9 A. M. to noon, and from 4 to 5 P. M., for consultation with the students and with others.

FRED W. ATKINSON, Ph.D., *President.*

THE REGISTRAR is in his office, in the College of Arts and Engineering Building, daily, during sessions, from 9 A. M. to 12.30 P. M., and from 2.30 to 5 P. M.

On Tuesday, Wednesday, and Thursday, the Registrar's office will be open, for purposes of registration and consultation regarding Evening Courses, from 2.30 to 5 P. M., and from 7.15 to 8.15 P. M.

CHARLES A. GREEN, A.M., *Registrar*

THE BURSAR'S OFFICE is open for the transaction of business, daily, during sessions, from 8.30 A. M. to 3 P. M. Catalogues may be obtained by addressing the Bursar.

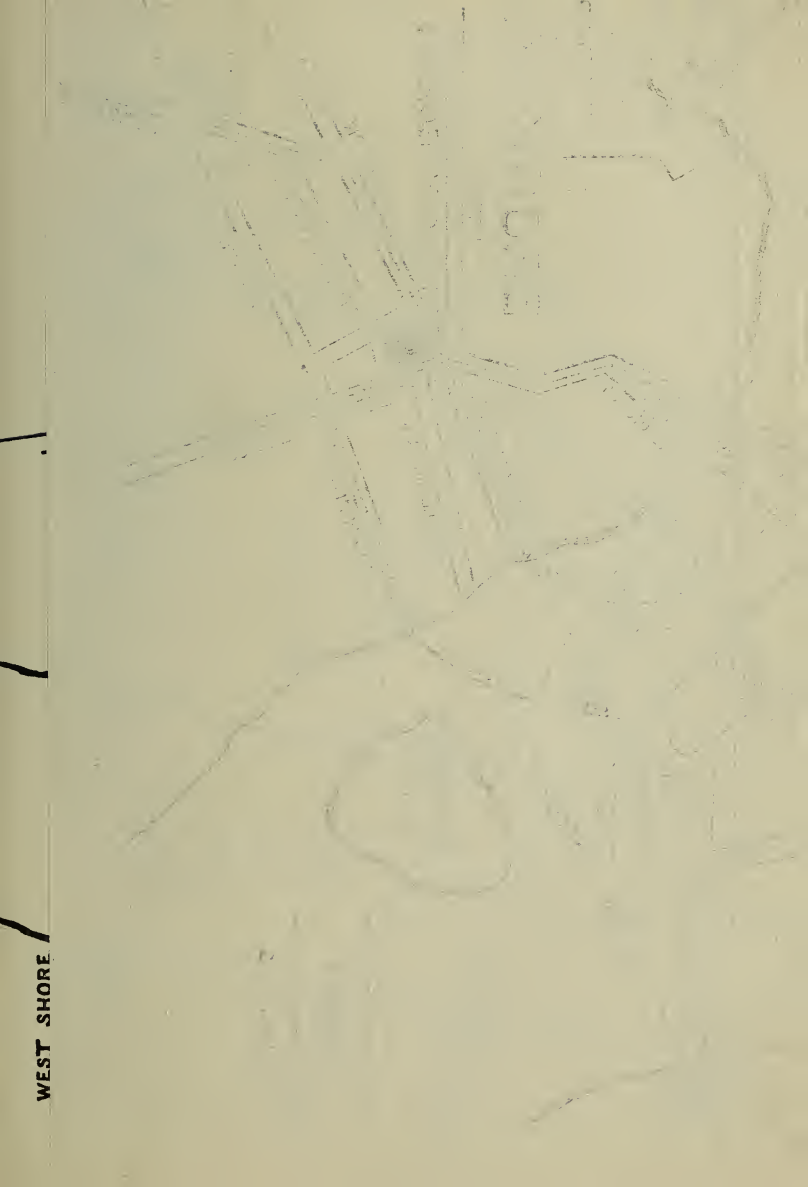
FRANCES A. NICOLL, *Bursar.*

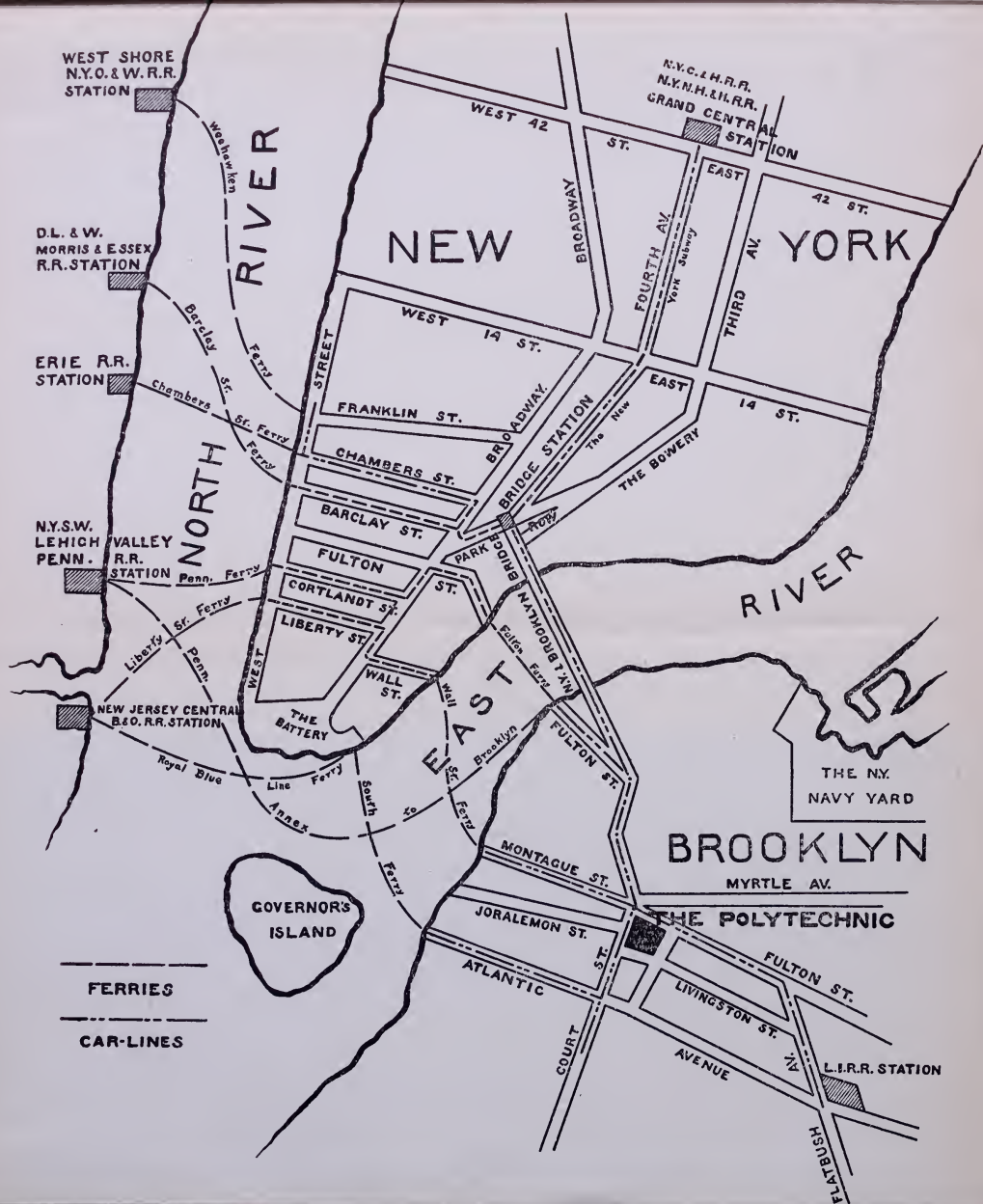
THE SPICER LIBRARY is open for the use of students, daily, during sessions, from 8.30 A. M. to 5 P. M.

ERNEST J. STREUBEL, A.M., *Librarian.*

THE GYMNASIUM AND BATHS are open for the use of students, except during vacation, without extra charge. All gymnasium work is under the immediate regulation of the Director.

HENRY H. WEIKEL, *Director.*





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J. HAMPDEN DOUGHERTY, HENRY SANGER SNOW.

Officers of Instruction*

FRED W. ATKINSON, *President and Professor of Education.*

B.A., Harvard University, 1890; Ph.D., University of Leipzig, 1893; Head of Science Department of High School and Academy of Westfield, Mass., 1890-91; Student in Universities of Berlin, Halle, Leipzig, Jena, and at the Sorbonne, 1891-94; Principal of High School, Springfield, Mass., 1894-1900; General Superintendent of Education in the Philippine Islands, 1900-03; Superintendent of Schools, Newton, Mass., 1903-04; President, Polytechnic Institute of Brooklyn, from 1904.

CONSTANTINE HERZBERG, *Professor Emeritus of Drawing and Design.*

Graduate of the Royal School of Design, Dresden, 1852; Student of Ludwig Richter, 1852-53; Practical Designing, New York, 1853-58; Professor of Drawing, Cooper Union, 1859-76; Professor of Drawing, Collegiate and Polytechnic Institute of Brooklyn, 1860-90; Professor of Drawing and Design, Polytechnic Institute of Brooklyn (the College), 1890-1907; Professor Emeritus from 1907.

GEORGE WASHINGTON PLYMPTON, *Professor Emeritus of Civil Engineering.*

C.E., Rensselaer Polytechnic, 1847; A.M., Hamilton College, 1854; M.D., Long Island College Hospital, 1877; Professor of Engineering and Architecture, Cleveland University, 1852-53; Professor of Mathematics, State Normal School, Albany, N. Y., 1853-56; Professor of Physics and Engineering, State Normal School, Trenton, N. J., 1857-63; Professor of Physical Science, Brooklyn Collegiate and Polytechnic Institute, 1863-90; Professor of Chemistry and Toxicology, Long Island College Hospital, 1864-86; Professor of Physics, Cooper Union, New York, from 1869; Director of Schools, Cooper Union, New York, from 1879; Professor of Civil Engineering, Polytechnic Institute of Brooklyn (the College), 1890-05; Professor Emeritus, from 1905.

RUFUS SHELDON, *Professor Emeritus of Pure Mathematics.*

B.A., Hamilton College, 1851; LL.B., 1853; A.M., Rochester University, 1864; Principal Auburn Academy, 1853-57; Professor of Mathematics, N. J. Normal School, Trenton, N. J.,

*In the order of appointment to Professorships, with exception of the President.

1857-63; Professor of Pure Mathematics, Polytechnic Institute of Brooklyn, 1863-1900; Professor of Mathematics, Cooper Union, from 1892; Professor Emeritus, Polytechnic Institute of Brooklyn (the College), from 1900.

BRAINERD KELLOGG, *Professor Emeritus of English and Philosophy.*

B.A., Middlebury College, 1858; A.M., 1860; LL.D., 1890; Principal Kirksville Schools, Kirksville, Ky., 1858-59; Principal of Macedon Academy, Macedon, N. Y., 1859-60; Tutor, Middlebury College, 1860-61; Professor of English Language and Literature, 1861-68; Professor of English Language and Literature, Brooklyn Collegiate and Polytechnic Institute, 1868-99; Dean of the Faculty, 1899-1907; Professor of English and Philosophy (the College), 1900-07; Professor Emeritus, from 1907.

CHARLES AMI LADOR, *Professor Emeritus of French Language and Literature.*

Lausanne Académie, 1860-64; Sorbonne and Collège de France, 1864-66; Union Theological Seminary, New York, 1869-72; Professor of French Language and Literature, Robert College, Constantinople, 1866-67; Professor, Institut de Belle Rive, Vevey, 1868-69; Professor of French Language and Literature, Williston Seminary, Easthampton, Mass., 1872-80; Pastor at Vaucluse, France, 1880-84; Pastor of French Evangelical Church, Woodhaven, L. I., from 1887; Professor of French Language and Literature, Polytechnic Institute of Brooklyn (the College), 1886-1907; Professor Emeritus, from 1907.

GUSTAVE ALEXANDRE CARTEAUX, *Professor of the French Language.*

Vesoul Ecole Normale et Lycée, 1870-76; Sorbonne, 1878; Professor of French Language and Literature, New York Private Schools, 1882-86; Director of French Instruction, Brooklyn Teachers' Association, from 1892; Adjunct Professor of the French Language, Polytechnic Institute of Brooklyn, 1886-92; Professor of the French Language (the College), from 1892.

SAMUEL SHELDON, *Professor of Physics and Electrical Engineering.*

B.A., Middlebury College, 1883; A.M., 1886; Ph.D., Würzburg University, 1888; D.Sc., University of Pennsylvania, 1906; Instructor in Mathematics, Middlebury College, 1883-85; Student at Würzburg University, 1885-86; Assistant in Physics, Würzburg University, 1886-88; Assistant in Physics, Harvard University, 1888-89; Director of the John Fritz Medal Association; President of the Department of Electricity, Brooklyn Institute of Arts and Sciences; Second Vice-President of the United Engineering Society; President of the American Institute of Electrical Engineers, from 1906; Professor of Physics and Electrical Engineering, Polytechnic Institute of Brooklyn (the College), from 1889.

GEORGE STUART COLLINS, *Professor of Modern Languages and Literatures.*

Ph.D., University of Leipzig, 1892; Student in France, Italy and Germany, 1885-92; Professor of the German Language and Literature, Polytechnic Institute of Brooklyn (the College), 1892-1905; Professor of Modern Languages and Literatures, from 1905.

IRVING WETHERBEE FAY, *Professor of Chemistry.*

B.A., Harvard University, 1886; Ph.D., Berlin University, 1896; Instructor in Science, Montpelier Seminary, Montpelier, Vt., 1886-87; Instructor in Physics and Chemistry, Belmont School, Belmont, Cal., 1887-93; Student in Heidelberg University, 1893-94, and Berlin University, 1894-96; Parker Fellow of Harvard, 1895-96; Instructor in Chemistry, University of Maine, 1896; Professor of Chemistry, Ohio University, 1896-97; Lecturer in Chemistry, Brooklyn Institute, from 1899; Professor of Chemistry, Polytechnic Institute of Brooklyn (the College), from 1897.

JONATHAN BRACE CHITTENDEN, *Professor of Pure and Applied Mathematics.*

B.S., Worcester Polytechnic Institute, 1888; B.A., Harvard University, 1889; A.M., 1890; Shattuck Scholar, 1890; Kirkland Fellow, 1891; Parker Fellow, 1892; Ph.D., Königsberg University, 1893; Instructor in Mathematics, Princeton University, 1893-95; Instructor in Mathematics, Columbia University and Barnard College, 1895-1900; Lecturer, Cooper Union and Brooklyn Institute; Admitted to New York Bar, 1901; Professor of Pure and Applied Mathematics, Polytechnic Institute of Brooklyn (the College), from 1900.

FRANK WADLEIGH CHANDLER, *Professor of English.*

B.A., Polytechnic Institute of Brooklyn, 1894; A.M., Columbia University, 1896; Ph.D., 1899; Student in Oxford, London and Paris, 1898-99; Instructor in English, Polytechnic Institute of Brooklyn, 1899-1900; Assistant Professor of Literature and History, 1900-02; Assistant in Comparative Literature, Columbia University, 1900-01; Lecturer in Comparative Literature, 1901-04; Extension Lecturer in Romance Literature, 1904-05; Lecturer, School of Pedagogy, Brooklyn Institute, 1902-03; Lecturer, Brooklyn Teachers' Association, from 1905; Professor of Literature and History, Polytechnic Institute of Brooklyn (the College), 1902-07; Professor of English, from 1907; Secretary of the Faculty, from 1904.

JOHN CHARLES OLSEN, *Professor of Analytical Chemistry.*

B.A., Knox College, 1890; A.M., 1893; Ph.D., Johns Hopkins University, 1900; Instructor in Science, High School, Jerseyville, Ill., 1890-91; Principal of Public Schools, Ipava, Ill., 1891-94; Student at Johns Hopkins University, 1894-95; 1898-1900; Fellow in Chemistry, 1899-1900; Student at Chicago University, summers of 1897 and 1898; Instructor in Chemistry and

Physics, Austin High School, Chicago, Ill., 1895-98; Instructor in Chemistry, Pratt Institute, Brooklyn, from 1900; Assistant Professor of Analytical Chemistry, Polytechnic Institute of Brooklyn (the College), 1900-02; Professor of Analytical Chemistry, from 1902.

CHARLES MILTON SPOFFORD, *Professor of Civil Engineering.*

S. B., Massachusetts Institute of Technology, 1893; Graduate Student of Civil Engineering, 1894; Assistant in Civil Engineering, Massachusetts Institute of Technology, 1896-1897; Instructor of Civil Engineering, 1897-1903; Assistant Professor of Civil Engineering, 1903-1905; Professor Civil Engineering, Polytechnic Institute of Brooklyn (the College) from 1905; with Phoenix Bridge Company, 1894-1896, and summers of 1897-1900 inclusive; engaged in special Bridge Design Problems, Engineering Department, City of Boston, since 1901.

CHARLES ARCHIBALD GREEN, *Professor of History and Economics.*

B.A., Hamilton College, 1896; A.M., 1900; Lecturer in Economics and Government, Brooklyn Y. M. C. A., from 1900; Lecturer in American Political History, Cooper Union, from 1904; Instructor in Political and Social Science, Polytechnic Institute of Brooklyn (the College), 1899-1902; Registrar, from 1899; Assistant Professor of Political and Social Science, 1902-07; Professor of History and Economics, from 1907.

WILLIAM D. ENNIS, *Professor of Mechanical Engineering.*

M.E., Stevens Institute of Technology, 1897; Machinist-apprentice, Rogers Locomotive Company, 1892-93; Assistant to Chief Engineer, Passaic Rolling Mill Company, 1895-96; Instructor in Mechanical Drafting, Jersey City Y. M. C. A., 1896-97; Electrician with the Consolidated Gas Company of New Jersey, 1897-98; Mechanical Engineer, Walworth Construction and Supply Company, Boston, Mass.; Chief Engineer with Tower and Wallace, Consulting Engineers; Mechanical Expert and Supervisor in the State of Washington of the Everett Pulp and Paper Company, the Puget Sound Reduction Company, the Monte Cristo Railway Company, the Monte Cristo Mining and Construction Company, the Everett Railway and Electric Company, and the American Linseed Company, 1901-04; Consulting Engineer, the Everett Pulp and Paper Company, 1904-05; Advisory Engineer, American Locomotive Company, 1905-07; Contributor to Technical Periodicals; Professor of Mechanical Engineering, Polytechnic Institute of Brooklyn (the College), from 1907.

RALPH C. TAGGART, *Acting Professor of Mechanical Engineering.*

Ph.B., University of Michigan, 1897; M.E., Lewis Institute, Chicago, 1901; Instructor, Grand Rapids High School, 1897-98; Instructor in Physics and Electrical Engineering, Lewis

Institute, 1898-1901; Assistant Engineer, George A. Fuller Co., 1901-02; Assistant Engineer, William J. Baldwin, Consulting Engineer, 1902-06; Associate Engineer, with William J. Baldwin, from 1906; Acting Professor of Mechanical Engineering, Polytechnic Institute of Brooklyn (the College), from 1906.

ANDREW WHEATLEY EDSON, *Professor of the Methods of Education.*

Graduate of the Randolph, Vermont, State Normal School, 1870; Montpelier Seminary, 1874; B.A., Dartmouth College, 1878; A.M., 1881; Principal, West Randolph High School, 1878-79; Principal of the Randolph State Normal School, 1879-84; Superintendent of Schools, Attleboro, Mass., 1884-85; Superintendent of Schools, Jersey City, 1885-87; Assistant State Superintendent of Schools, Massachusetts, 1887-97; Assistant Superintendent of Schools, New York City, 1897-1902; Associate City Superintendent of Schools, from 1902; Instructor in Summer Schools in Vermont, Washington, and Indiana, 1880-90; Manager of the School of Methods and Instructor in School Management at the Martha's Vineyard Summer Institute, 1888-98; Instructor in School Management and School Supervision, Columbia University Summer School, 1902 and 1903; Professor of the Methods of Education, Polytechnic Institute of Brooklyn (the College), from 1905.

EDWIN GAYLORD WARNER, *Assistant Professor of Latin.*

B.A., Amherst College, 1885; Ph.D., New York University, 1892; Instructor in Greek and Latin, Polytechnic Preparatory School, 1885-1900; Head of Department of Latin, from 1900; Assistant Professor of Latin, Polytechnic Institute (the College), from 1905.

EDWARD SOUTHWORTH HAWES, *Assistant Professor of Greek.*

B.A., Harvard University, 1880; A.M., 1882; Ph.D., 1884; Student in the University of Bonn, Germany, 1884-86; Instructor in Greek and Latin, Harvard University, 1882-84; Head of the Department of Classics, Cathedral School of St. Paul, Garden City, N. Y., 1886-90; Instructor in Latin and Greek, Norwich Academy, Norwich, Conn., 1891-92; Head of Department of Classics, Polytechnic Preparatory School, 1892-1900; Head of Department of Greek, from 1900; Assistant Professor of Greek, Polytechnic Institute (the College), from 1905.

WILLIAM PEPPERELL MONTAGUE, *Acting Professor of Philosophy.*

A.B., Harvard University, 1896; A.M., 1897; Highest Honors in Philosophy; Ph.D., 1898; Privat Dozent, Harvard University, and Instructor in Philosophy, Radcliffe College, 1898-99; Instructor in Philosophy, University of California, 1899-1903; Lecturer in Philosophy, Columbia University, 1903-04; Tutor in Philosophy, 1904-05; Instructor in Philosophy, 1905-07;

Adjunct-Professor of Philosophy, from 1907; Head of the Department of Philosophy, Barnard College, from 1907; Member of the American Philosophical Association, the American Psychological Association, Associate Member of the New York Academy of Sciences; Fellow of the American Association for the Advancement of Science; Acting Professor of Philosophy, Polytechnic Institute of Brooklyn (the College), from 1907.

FREDERIC A. C. PERRINE, *Consulting Professor of Long-Distance Electric Power Transmission.*

B.A., Princeton University, 1883; B.S., 1885; D.Sc., 1885; A.M., 1886; Manager of Insulated Wire Department of John A. Roebling's Sons Co., 1889-92; Treasurer Germania Electric Co., 1892-93; Professor of Electrical Engineering, Leland Stanford, Jr., University, 1893-1900; Chief Engineer of Standard Electric Co., 1898-1900; President of Stanley Electric Manufacturing Co., 1900-04; Consulting Electrical Engineer, from 1904; Editor of *Journal of Electricity*, 1891-93; Editor of *Electrical Engineering*, 1893-95; Consulting Professor of Long-Distance Electric Power Transmission, Polytechnic Institute (the College), from 1905.

CYPRIEN O. MAILLOUX, *Consulting Professor of Electric Train Movement.*

E.E., Polytechnic Institute of Brooklyn, 1905; M.S., 1906; Writer on Electrical Subjects in "The Operator," 1882; First Editor of "The Electrical World," 1883-84; Consulting Electrician, Johnston's Patent Agency, 1883-84; Consulting Electrical Engineer in general practice, from 1883; Inventor and Patentee of apparatus, methods and systems relating to arc-lighting, storage batteries, electric traction, electric stations, electric load and feeder equalization; President, New York Electrical Society, 1897-98; Vice-President, Section B, International Electrical Congress, Paris, 1900; Delegate to the International Electrotechnical Commission, London, 1907; Lecturer in Lehigh University, Colorado College, and Delaware College, 1903-04; Consulting Professor of Electric Train Movement, Polytechnic Institute of Brooklyn (the College), from 1905.

GEORGE C. WHIPPLE, *Consulting Professor of Sanitary and Industrial Water Supply.*

B.S., Massachusetts Institute of Technology, 1889; Biologist Boston Waterworks, 1889-97; Biologist and Director Mt. Prospect Laboratories, New York, 1897-1904; Engineer Department of Chemistry and Biology of New York Commission on Additional Water Supply; Sanitary Expert for St. Louis on Chicago Canal Case; Sanitary Expert for the cities of Cleveland, Augusta, Jersey City; now of the firm of Hazen & Whipple, Consulting Engineers, New York City; Consulting Professor of Sanitary and Industrial Water Supply, Polytechnic Institute (the College), from 1905.

RALPH D. MERSHON, *Consulting Professor of Prime Motors.*

M.E., Ohio State University, 1890; Assistant Electrical Engineer, Westinghouse Electric and Manufacturing Co., Pittsburgh and New York, 1891-1900; Representative of the Westinghouse Company at the World's Industrial Exposition, 1893; Inventor of Electrical devices, including the Mershon Compensator and Improved Six Phase Rotary Converter; Recipient of the John Scott Medal of the Franklin Institute of Philadelphia; Vice-President of the American Institute of Electrical Engineers; Consulting Engineer, New York, since 1900; Consulting Professor of Prime Motors, Polytechnic Institute of Brooklyn (the College), from 1906.

CHARLES P. STEINMETZ, *Consulting Professor of Radiation, Light, and Illumination.*

A.M., Harvard University, 1902; Ph.D., Union University, 1903; Student in the University of Breslau, 1882-88; in the University of Zürich, 1888-89; in the Eickemeyer Laboratory, 1889-92; Consulting Engineer, General Electric Company, from 1893; Professor of Electrical Engineering, Union University, from 1903; Member of the Mathematical Society, the Physical Society; President of the American Institute of Electrical Engineers, 1901-02; Chairman of Section B, International Electrical Congress, 1904; Consulting Professor of Radiation, Light and Illumination, Polytechnic Institute of Brooklyn (the College), from 1907.

HENRY ROGERS CODWISE, *Instructor in Engineering.*

B.S., Polytechnic Institute of Brooklyn, 1899; Instructor in Mathematics and Surveying, Cooper Union, from 1900; Assistant in Engineering, Polytechnic Institute of Brooklyn (the College), 1899-1901; Instructor in Engineering, from 1901.

CHARLES HORATIO PERRY, *Instructor in Mechanical Laboratory.*

Practical Mechanic, U. S. Shoe Machinery Co., Beverly, Mass., 1895-98; Student in Massachusetts Institute of Technology, 1898-99; Machinist, Baldwin Locomotive Works, Philadelphia, 1899-1900; Constructor of Engineering Apparatus for Hydraulic Laboratories of Ohio State University, 1902; Assistant in Mechanical Laboratory, Polytechnic Institute of Brooklyn (the College), 1900-01; Instructor in Mechanical Laboratory, from 1901.

SIDNEY WHITMORE ASHE, *Instructor in Physics and Electrical Engineering.*

B.S., Cooper Union, 1902; E.E., Polytechnic Institute of Brooklyn, 1905; Assistant in Physics, Polytechnic Institute of Brooklyn, 1899-1902; Instructor in Laboratory, Amer-

ican Institute of Arts and Sciences, New York, 1902-03; Instructor in Electrical Engineering for Brooklyn Rapid Transit Co., from 1903; Instructor in Physics and Electrical Engineering, Polytechnic Institute of Brooklyn (the College), from 1902.

WILLIAM J. BERRY, *Instructor in Mathematics.*

C.E., Polytechnic Institute of Brooklyn, 1903; M.S., 1904; Assistant in Mathematics, Polytechnic Institute of Brooklyn (the College); 1903-04; Instructor in Mathematics, from 1904.

WALTER HOLBROOK ADAMS, *Instructor in Mechanical Engineering and Mechanical Drawing.*

S.B., Massachusetts Institute of Technology, 1903; Assistant in Mechanical Engineering, Massachusetts Institute of Technology, 1903-05; Instructor in Mechanical Engineering, 1905; Assistant Mechanical Engineer, Frank B. Gilbert, General Contractor, 1903; Draftsman, B. F. Sturtevant Co., 1904; Designer with United Concrete Machinery Co., 1905; Instructor in Mechanical Engineering and Mechanical Drawing, Polytechnic Institute of Brooklyn (the College) from 1905.

J. F. OAKLEAF, *Laboratory Instructor.*

Special Student in Chemistry, Polytechnic Institute of Brooklyn, 1901-04; Assistant in Chemistry, 1905-06; Laboratory Instructor, from 1906.

ERNEST JOHN STREUBEL, *Instructor in English.*

B.A., Polytechnic Institute of Brooklyn, 1905; A.M., 1906; Instructor in English, Brooklyn Y. M. C. A., from 1905; Assistant in English and Assistant Librarian, Polytechnic Institute of Brooklyn (the College), 1905-06; Instructor in English and Librarian, from 1907.

FREDERICK LJUNG, *Instructor in Civil Engineering.*

C.E., Polytechnic Institute of Brooklyn, 1906; Assistant in Civil Engineering, 1906-07; Instructor in Civil Engineering, from 1907.

WILLIAM B. KOUWENHOVEN, *Instructor in Laboratory Physics.*

E.E., Polytechnic Institute of Brooklyn, 1906; M.E., 1907; Assistant in Laboratory Physics, 1906-07; Instructor in Laboratory Physics, from 1907.

ROLAND S. CHILD, *Instructor in Mathematics.*

E.E., Polytechnic Institute of Brooklyn, 1906; Assistant in Mathematics, 1906-07; Instructor in Mathematics, from 1907.

M. C. WHIPPLE, *Instructor in Water Laboratory.*

Student in Chemistry, Polytechnic Institute of Brooklyn, 1903-06; Student-Assistant in Chemistry, 1905-06; Instructor in Water Laboratory, from 1907.

WILLIAM ECHARD GOLDEN, *Lecturer in English.*

B.A., Indiana University, 1888; A.M., 1890; Student Columbia University, 1889-90; Principal of New Harmony High School, New Harmony, Ind., 1897-98; Instructor in English, Polytechnic Institute of Brooklyn, 1890-93; Dramatic Author, 1893-97; Instructor in English, Polytechnic Preparatory School, 1898-1900; Head of Department of English, from 1900; Lecturer in English, Polytechnic Institute (the College), from 1905.

AUGUSTUS SAMUEL BEATMAN, *Lecturer in History.*

A.B., Harvard University, 1903; A.M., 1905; Student, Oneonta State Normal School, Oneonta, N. Y., 1896-97; Assistant in History, Harvard University, 1904-05; Head of Department of History, Polytechnic Preparatory School, from 1905; Lecturer in History, Polytechnic Institute (the College), from 1905.

WILLIAM CARY DUNCAN, *Lecturer in English.*

B.A., Amherst College, 1897; Instructor in Oratory, Polytechnic Preparatory School, 1897-1901; Head of the Department of Elocution, from 1901; Lecturer in English, Polytechnic Institute (the College), from 1905.

CLAYTON AMES PETERS, *Lecturer in Biology.*

B.S., University of Michigan, 1895; M.S., 1897; Student at Cold Spring Harbor Biological Laboratory, 1901; Head of Department of Biology, State Normal School, Edinboro, Penn., 1897-1901; Head of Department of Biology, Polytechnic Preparatory School, from 1901; Lecturer in Biology, Polytechnic Institute (the College), from 1905.

CLAUS JOHANN SCHWARZ, *Lecturer in German.*

Graduate of the Wilhelm Gymnasium, Hamburg, 1893; Teacher of German, Paris, 1894-97; Instructor in German, Berlitz School, Boston, Mass., 1899-1900; Washington, D. C., 1900-02; Instructor in German, Polytechnic Preparatory School, from 1902; Lecturer in German, Polytechnic Institute (the College), from 1905.

DWIGHT RALSTON LITTLE, *Lecturer in Education.*

B.A., Williams College, 1900; A.M., New York University, 1903; Pd.M., 1904; Graduate Student, 1902-05; Instructor in

English and Latin, Polytechnic Preparatory School, from 1900; Lecturer in Education, Polytechnic Institute (the College), from 1905.

HENRY G. HARTMANN, *Lecturer in Ethics.*

B.A., Polytechnic Institute of Brooklyn, 1900; A.M., Columbia University, 1903; Instructor in Mathematics, Polytechnic Preparatory School, 1900-1901; Instructor in Mathematics, Cooper Union, New York, from 1901; Lecturer in Ethics, Polytechnic Institute (the College), from 1906.

GILBERT HOLLAND MONTAGUE, *Lecturer on Law of Contracts.*

B.A., Harvard University, 1901; A.M., 1902; LL.B., 1904; Instructor in Economics, Harvard University, 1902-04; Counselor at Law, in New York, from 1904; Lecturer on Law of Contracts, Polytechnic Institute of Brooklyn (the College), from 1906.

JAMES E. BARLOW, *Assistant in Surveying.*

S.B., Massachusetts Institute of Technology, 1905; Assistant Engineer, Board of Water Supply, New York; Assistant in Surveying, Polytechnic Institute of Brooklyn (the College), from 1906.

WILLIAM C. PICKERSGILL, *Assistant in Surveying.*

S.B., Massachusetts Institute of Technology, 1905; Assistant Engineer, Board of Water Supply, New York; Assistant in Surveying, Polytechnic Institute of Brooklyn (the College), from 1906.

EDGAR F. SMITH, *Assistant in Surveying.*

A.B., Boston University, 1900; S.B., Massachusetts Institute of Technology, 1904; Assistant Engineer, International Paper Co., New York; Assistant in Surveying, Polytechnic Institute of Brooklyn (the College), from 1906.

GEORGE C. TUTHERLY, *Assistant in Railway Curves and Earthwork.*

C.E., Polytechnic Institute of Brooklyn, 1904; Draftsman Rapid Transit Subway Construction Co., New York; Assistant in Railway Curves and Earthwork, Polytechnic Institute of Brooklyn (the College), from 1906.

ANDREW S. HEGEMAN, *Assistant in Mathematics.*

E.E., Polytechnic Institute of Brooklyn, 1907; Assistant in Mathematics, from 1907.

GEORGE ALDER, *Student-Assistant in Shopwork.*

E.E., Polytechnic Institute of Brooklyn, 1907; Student-Assistant in Shopwork, from 1906.

MERRILL G. HAWKINS, *Student-Assistant in Chemistry.*

Student in Chemistry, Illinois Wesleyan, 1905-06; Student in Chemistry, Polytechnic Institute of Brooklyn, from 1906; Student-Assistant in Chemistry, from 1906.

HENRY HUMMEL WEIKEL, *Director of the Gymnasium.*

Graduate of the Y. M. C. A. Training School, Chicago, 1893; Member of the Society of College Gymnasium Directors; Assistant Physical Director of Central Department Y. M. C. A., Chicago, and Instructor in the Y. M. C. A. Training School, 1893-96; Physical Director of the Indianapolis Y. M. C. A., 1896-97; Physical Director of the Central Branch Y. M. C. A. of Brooklyn, 1897-1902; Director of Boys' Clubs, Madison Square Church House, New York, 1903-05; Director of the Gymnasium, Polytechnic Institute of Brooklyn, from 1905.

Other Officers

CHARLES ARCHIBALD GREEN, *Registrar.*

B.A., Hamilton College, 1896; A.M., 1900.

ERNEST JOHN STREUBEL, *Librarian.*

B.A., Polytechnic Institute, 1905, A.M., 1906.

ELIZABETH H. ARNOLD, *Secretary to the President.*

FRANCES A. NICOLL, *Bursar.*

EDITH C. MCBRIDE, *Assistant to the Bursar.*

HILDA LUDEMAN, *Stenographer.*

WILLIAM OSCAR LINDHOLM, *Superintendent of Buildings.*

FRANK ELLIS, *Engineer of Buildings.*

Faculty

PRESIDENT ATKINSON, *Chairman.*

PROFESSOR CARTEAUX,

PROFESSOR SHELDON,

PROFESSOR COLLINS,

PROFESSOR FAY,

PROFESSOR CHITTENDEN,

PROFESSOR CHANDLER, *Secretary,*

PROFESSOR OLSEN,

PROFESSOR SPOFFORD,

PROFESSOR GREEN,

PROFESSOR ENNIS.

Standing Committees of the Faculty

On Curriculum and Standing.

PROFESSORS SHELDON, CHITTENDEN, FAY, CHANDLER,
SPOFFORD, AND ENNIS; PRESIDENT ATKINSON,
AND PROFESSOR GREEN.

On Publications.

PROFESSORS CHANDLER, SHELDON AND SPOFFORD.

On Library.

PROFESSORS CARTEAUX, CHANDLER, AND COLLINS.

On Apparatus and Collections.

PROFESSORS FAY, SPOFFORD, AND ENNIS.

On Extension Studies.

PROFESSORS SPOFFORD, SHELDON, CHANDLER, CARTEAUX,
GREEN, AND ENNIS.

On Student Aid.

PROFESSOR OLSEN, co-operating with MR. FROTHINGHAM
of the Corporation, with MR. CHILD of the
Alumni; and with PRESIDENT ATKINSON
and PROFESSOR GREEN.

General and Historical Statement

The Polytechnic Institute of Brooklyn comprises two general departments, the College of Arts and Engineering and the Preparatory School. These are in all respects distinct from each other, and their work is conducted in different buildings under separate direction. The Preparatory School equips students for entrance into any American college, and provides also a special course of instruction for those desiring to fit themselves for mercantile life.* The College of Arts and Engineering, to which this catalogue alone refers, comprehends all the higher educational work of the Polytechnic, offering, in its regular courses to men, and in its extension courses to men and women, the broadest opportunities for collegiate and professional instruction in science and liberal arts.

The present Polytechnic is the outgrowth of the Brooklyn Collegiate and Polytechnic Institute, founded in 1853, incorporated by the Board of Regents of the State of New York in 1854, and opened for the reception of students in Sep-

*The Annual Register of the Preparatory School may be had on application.

tember, 1855. Its curriculum, at first mainly preparatory for college and for business pursuits, was enlarged until by the year 1870 two courses of study had been provided, leading to the degrees of Bachelor of Science and Bachelor of Arts.

With the increase in the number of its students, and the extension of its educational work, additional buildings and equipment became necessary, the work of the Preparatory or Academic Department requiring the whole of the building heretofore occupied by the Institute to accommodate its classes. In view of these facts, and because of the limited powers conferred by the original charter, it was at length determined to surrender the charter of the academy, and in its place to procure the incorporation of a new institution, which should afford scope for growth and development, and gain the power and right to acquire and receive property by purchase, gift or will. This purpose was accomplished during 1889. On August 8 of that year, a provisional charter of incorporation was granted by the Regents of the University of the State of New York to the Polytechnic Institute of Brooklyn. In September following, the new corporation duly acquired the lands, buildings and equipment of the Brooklyn Collegiate and Polytechnic Institute, and assumed the educational work formerly conducted by the academy. Before the expiration

of the year, the Institute acquired the endowment prescribed by law for an absolute charter, which was duly granted in January, 1890, and in 1891 the new building, equipped with laboratories, library, gymnasium and every modern convenience, was occupied.

Since 1889 the development of the Polytechnic's curriculum has been continuous. In that year the Science Course was resolved into Courses of Chemistry, Civil, and Electrical Engineering. The first degrees of Electrical Engineer were bestowed in 1893 and the first of Civil Engineer in 1897, their recipients being holders of the Bachelor of Science degree who had completed one year of graduate study. In 1899 a Course in Mechanical Engineering was established and fully equipped machine shops, hydraulic and engine laboratories were installed. In 1900 the requirements for entrance to and pursuance of courses had been so far advanced that power was given by the Regents to grant the degrees of Electrical, Civil, and Mechanical Engineer upon the completion of stated courses of four years' duration. The power to grant the graduate degrees of Master of Arts and Master of Science was also conferred in 1903, and definite requirements were provided for fulfillment of the grant. In 1904 the title of College of Arts and Engineering was adopted to designate the higher department of the Polytechnic Institute, and a compre-

hensive system of afternoon and evening extension courses was opened to men and women desiring instruction in Arts, Chemistry, and Engineering. Furthermore, the educational efficiency of the College was greatly enhanced by the appointment of a board of Consulting Professors, recognized experts in various fields of applied science. With the year 1905 a course in Chemical Engineering was inaugurated and the course in Arts was reorganized and broadened by the establishment of new departments, including courses in theoretical and practical education for teachers and those preparing to enter that profession.

College Charter

WHEREAS, we, the Regents of the University of the State of New York, duly granted, upon the 8th day of August, 1889, a provisional charter incorporating the Polytechnic Institute of Brooklyn; and

WHEREAS, the said corporation has now, within the period limited by the said charter, submitted to us satisfactory evidence that it has fully complied with the conditions prescribed by law for an absolute charter, and has made application that the same be granted;

NOW, THEREFORE, WE, THE REGENTS OF THE UNIVERSITY OF THE STATE OF NEW YORK, by virtue of the authority vested in us, do hereby grant unto the said corporation, the

POLYTECHNIC INSTITUTE OF BROOKLYN.

a charter absolute, with all the rights, powers, and dignities given by law and by the ordinances of the Regents to a College, including membership in the University of the State of New York, representation in its convocations, and all other privileges thereunto appertaining.

The number of members of the said corporation shall not exceed twenty-one; seven of whom shall form a quorum for the transaction of business.

The said corporation shall have power to con-

duct an academic or preparatory department in connection with the Institute.

The said Institute may confer on such persons as shall complete, to the satisfaction of its faculty, courses of study approved by the Regents, such degrees as may be granted by other colleges or institutions of learning in the United States, and in testimony thereof, award suitable diplomas under the seal of the corporation.

DIPLOMAS AND DEGREES conferred by the said Institution under the authority hereby granted, shall entitle the holders thereof to all immunities and privileges allowed by usage, or by law, to the possessors of like diplomas and degrees from any college or university.

IN WITNESS WHEREOF, we, the said Regents, have caused this charter to be issued under the seal of the University of the State of New York, and to be subscribed by the Chancellor and attested by the Secretary thereof.

Done at the Capitol in Albany, January thirtieth, one thousand eight hundred and ninety.

GEORGE WILLIAM CURTIS,
Chancellor.

MELVIL DEWEY,
Secretary.

Location

THE POLYTECHNIC INSTITUTE is situated in the Borough of Brooklyn of the City of New York, on Livingston and Court streets, immediately adjoining the City Hall Square. It occupies the most central and convenient place in the Borough and one of the most desirable locations in Greater New York, affording facilities for the examination and study of engineering works, machine shops and chemical and industrial processes, as well as ready access to the great libraries and art and natural history collections of the metropolis. The ample collections of the neighboring Brooklyn Public Library are available for the use of the students, while the Astor, Lenox and Columbia University Libraries offer opportunities for the prosecution of adjunct research.

In the engineering field, truss and suspension bridges, masonry and steel arches, plate girders, steel and reinforced concrete buildings, reservoirs, canals, tunnels, high dams, and drawbridges are all easily accessible to students. Extensive works are constantly in process of construction, and afford the best possible opportunity for the study of practical operations. Throughout the city most of the approved forms of pavement are

under trial, many modes of street-car propulsion are in use, while the extension of the water supply and sewerage systems affords unusual advantages for the study of the most important features of municipal engineering.

The variety and scope of processes open to inspection in the great factories are of especial service to those intending to become civil or mechanical engineers; for the power plants, the foundries, and shops for forging and milling metals, the blast furnaces, open hearth and Bessemer steel furnaces, and rolling mills for producing structural and other iron, the tool and die works, the locomotive works, weaving mills, water supply stations, and a great variety of enterprises are close at hand. New York presents also a great field for the study of locomotives and automobiles; its pump works are the most extensive; its elevator service is the greatest in passenger miles; its harbor can show the largest capacity of marine engines and propellers in the world; unrivalled opportunities are afforded for investigating the heating, ventilation and fire protection of buildings; and the city holds the largest aggregation of engines and turbines for producing power. Visits of inspection to these features are made either under the auspices of the Engineering Society of the College or as class exercises.

New York is the chemical city of the world. It contains not only the widest variety of chem-

ical engineering establishments to be found in a single community, but many of its plants are the largest of their kind. In or about Greater New York are located the world's most extensive customs analytical laboratory, the largest sugar refineries, glucose and starch manufactories, glycerine refineries, baking powder works, soap factories and electrolytic copper refineries. A single Brooklyn plant refines one-sixth of all the copper in the world. Within New York there are five hundred chemical manufacturing plants. The Chemical Society of the Institute visits works that manufacture colors, paints, silk, starch, leather, graphite, glass, soap, rubber, gas, ice, distilled water, matches, soda, agate, nickel-steel, copper, iron, and steel, as well as general chemical factories.

When the power-houses of New York, now under contract, are in operation, about a million electrical horse power will be generated. These power-houses could replace all the power and lighting central stations of Great Britain or Germany, or operate all the electric railways of Europe and Great Britain combined. One single station could supply all the electric railways of Germany; and a single generator could do the same for Switzerland.

Thus, with its congested passenger traffic and gigantic traction problems, with its unequalled electric illumination and the complexity of its

telephone and telegraph lines, New York is an ideal place for an electrical school.

The city itself is of invaluable utility to the student, and makes him realize that the aim of higher education is not merely the acquisition of scholarship, but rather and chiefly the study and practice of life. It is believed that the problems of any career can find solution to better advantage where every phase of life is expressed and society is seen in all its complexity, than in seclusion from the world of men and affairs and the centers of culture and art.

To the student of letters, philosophy, politics, art, history, science, or sociology, New York presents opportunities unrivalled for the attainment of culture. In the lectures of the Brooklyn Institute, covering a wide range of subjects, in the acted drama, in the opera, in every department of music, in architecture, in the collections and annual exhibitions of the plastic and graphic arts, the student enjoys advantages not elsewhere to be obtained.

Courses of Instruction

The regular curriculum of the College of Arts and Engineering of the Polytechnic Institute provides six undergraduate courses of four years each :

I. The Course in Arts leading to the degree of Bachelor of Arts ;

II. The Course in Chemistry leading to the degree of Bachelor of Science ;

III. The Course in Chemical Engineering leading to the degree of Chemical Engineer ;

IV. The Course in Civil Engineering leading to the degree of Civil Engineer ;

V. The Course in Electrical Engineering leading to the degree of Electrical Engineer ;

VI. The Course in Mechanical Engineering leading to the degree of Mechanical Engineer.

It provides also :

VII. Four combined Undergraduate and Graduate Arts and Engineering Courses leading to the degree of Bachelor of Arts in four years and the degree of (a) Chemical, (b) Civil, (c) Electrical, or (d) Mechanical Engineer, as the case may be, in six years ;

VIII. The Course in Pedagogy offered to teachers and others, to be taken separately or in

partial fulfillment of the requirements for the degree of Bachelor of Arts, or for those who already hold the Baccalaureate Degree in partial fulfillment of the requirements for the degree of Masters of Arts. This Course is approved by the educational authorities of both state and city and leads directly to examination for teachers' licenses.

There are further provided two graduate courses of one year each :

IX. The Graduate Course in Arts leading to the degree of Master of Arts ;

X. The Graduate Course in Science, in the departments of Mathematics, Chemistry, Chemical, Civil, Electrical, and Mechanical Engineering, leading to the degree of Master of Science.

In addition, the College offers for the benefit of mature persons who are unable to attend regular day sessions the two following groups of Courses :

XI. Courses for Teachers in Arts and Pedagogy, to be pursued with or without reference to the degrees of Bachelor of Arts and Master of Arts, in the afternoon, evening and Saturday Sessions ;

XII. Evening Courses in Engineering and Chemistry, to be pursued with or without refer-

ence to the degrees of Bachelor of Science, Chemical, Civil, Electrical, or Mechanical Engineer.

The following pages present a general account of the aims and requirements of each course (pages 40 to 82 inclusive), a series of schedules of such courses as can be so set forth by subjects and semesters (pages 83 to 121 inclusive), and a descriptive list of individual subjects of instruction arranged in departments (pages 123 to 201).

For convenience in reference, the subjects of instruction in the Courses for Teachers (XI) and the Evening Courses in Engineering and Chemistry (XII) will be found separately tabled and described at pages 205 and 215 respectively.

I.—Course in Arts

The Course in Arts offered by the Polytechnic Institute is designed to meet the requirements of those who seek a liberal education as the most intelligent basis for professional or industrial and business activity. Through systematic courses of wide range, it strives to develop roundly all the student's faculties, to equip him with a knowledge of essential facts in many departments of life, and to breed in him powers of independent thought and expression. Its aim is, therefore, to impart general culture, but a culture that shall prove efficient and not merely academic. The studies of the Arts Course are seldom spoken of as having a commercial value; yet one cannot advance in any profession, can hardly secure even a clerkship in any business, without knowing a good deal of what they teach, and possessing skill in the use of it. He who is equipped to do many things well must be proportionately more valuable than he who can do but few, and to men of efficient culture falls much of the world's highest work and rewards.

In the nature of the studies of this Course, however, its chief value lies. For they help powerfully in converting their votaries into cultivated and influential members of society, and this because of their subject matter and its expression. In all the varied curricula of study, no food can

be found more nutritious to the whole inner man than thought—thought literary, linguistic, historical, political and philosophical—and its embodiment in language; none more strengthening to intellect, refining to taste, stimulating to imagination, productive of enjoyment, regulative of conduct, and helpful to social position; none giving the student a fuller mastery of his knowledge and a firmer command of his faculties. At a time when education has become often intensely and narrowly practical, there is need that this be said with emphasis. The Polytechnic has recognized this truth in providing in addition to its courses in technology one in which the physical sciences do not overshadow all else. It also requires and advises that many studies of this course be a part of every other; so that in their attainments and discipline all its students shall more than meet the demands of the special callings they enter and preserve in them their poise as men.

For the first two years the subjects offered by the curriculum are mainly prescribed, with certain additional options; but in the last two years an increasing range of electives is presented, allowing of specialization according to individual tastes. All studies are pursued in the historical and critical method, with a view to their interrelations and the gradual unfolding of human thought. Instruction is given by means of lec-

tures, recitations, and reports and essays based on original research.

In the Freshman year the prescribed courses embrace the study of the theory and practice of rhetoric, a critical study of modern English prose, the history of the English language, debating, solid geometry, plane trigonometry and higher algebra, general chemistry, the plays of Shakespeare, mediaeval history, and two foreign languages, Latin, Greek, French or German; and optional courses are offered in oratory, descriptive and analytical geometry, theory of equations, free-hand drawing, laboratory practice in chemistry, carpentry and foundry, zoölogy, geology, and Spanish.

In the Sophomore year the prescribed subjects include the general outlines of English literature, detailed courses in Elizabethan, seventeenth and eighteenth century letters, the history of modern Europe, either the history of the Renaissance and Reformation or the history of France or English history, and two foreign languages and their literatures, Greek, Latin, French or German. Optional courses are offered also in drawing, differential calculus, theory of equations, integral calculus, analytical geometry, descriptive geometry, qualitative analysis, Spanish, oratory, mechanics and heat, carpentry and foundry, zoölogy, geology, surveying, history of education, and psychology.

In the Junior year the prescribed courses include nineteenth century literature, American political history, political economy, psychology, and one foreign language and literature—Greek, Latin, French, German, or Spanish, constituting an average of eight hours a week. An equal number of hours must be elected from a large number of subjects, including, in addition to all those offered as options in earlier years, science of language, logic, Anglo-Saxon, Chaucer, American literature, argumentative composition, the English novel, literary criticism, Tennyson and Browning, history of art, descriptive and practical astronomy, laboratory physics, general and industrial botany, educational psychology, principles of education, educational masterpieces, general methods of teaching, finance, sociology, architecture, Italian, forging, chipping and filing, heat and other motors, thermodynamics, alternating currents, dynamo electricity, testing materials, ancient and modern languages and literatures.

In the Senior year ancient and mediæval philosophy and ethics constitute the only prescribed courses, and to complete the Senior requirement of sixteen hours a week each semester, other courses must be chosen from a list of electives embracing some ninety different subjects and including, in addition to the group of Sophomore options and of Junior electives, such courses as

comparative constitutional law, international law, philosophy of education, school organization and administration, curriculum and methods of elementary school teaching, special methods of teaching, an extended course in the comparative study of literary types, advanced oratory, literary forms, aesthetics, special topics in United States history, modern philosophy, Spanish literature, machine work, tool-making, quantitative analysis, heating and ventilation, foundations, framed structures, telephone and telegraphy and patent practice, electric lighting, and central station practice. A thesis of not less than three thousand words dealing with some topic in history, literature, linguistics, education, political and social science, or philosophy must also be prepared and submitted to the department under whose direction it is written, on or before June first.

During both Junior and Senior years, students of the Course in Arts who intend to follow a profession should select electives with reference to that end. Those who desire to combine with the regular college course a course in technology will choose subjects from that field, and those who wish to combine pedagogical preparation with academic work will choose mainly subjects in education. Conference upon the choice of electives must be had with the President, not later than June first of the Sophomore or Junior year for Junior and Senior Electives of the first semes-

ter, and not later than February first of the Junior and Senior year for Junior and Senior Electives for the second semester.

The Course in Arts may be pursued with profit by any student, whatever the profession or occupation upon which he may enter in after life; and for two classes of the ambitious it is vital. First, for the professional man who would excel it offers the only sure foundation for specialized study. Second, for the practical man of affairs who would live most fully and wield the greatest power it is essential, since he cannot be confined in his interests and abilities to those of a single calling. He must be prepared to meet and master all sorts and conditions of problems and men, to judges of motives and spiritual values as well as material things, to appreciate letters and art, to share in the hopes and achievements of the race in philosophy, in politics and science, and to gain some notion of the laws which govern all phases of life, that he himself may live in accord with them more usefully and happily.

For a tabulated statement of prescribed and elective subjects of the Course in Arts, giving the semesters and number of hours devoted to each, consult pages 84 to 89 inclusive. For a descriptive account of each subject consult pages 123 to 201 inclusive.

II.—Course in Chemical Engineering

This course is intended to meet the requirements of students who intend to become managers or superintendents of factories or other chemical industries or who desire to qualify as manufacturing chemists. Since several years' experience as an analytical or research chemist is required of men desiring such positions, the engineering chemist must have a thorough knowledge of analytical and inorganic and organic chemistry. The training in fundamental principles of the science, as given in the Chemical Course (consult pages 49 to 52), is supplemented by some instruction in mechanical and electrical engineering, to familiarize the student with the principles of the production and use of power, so essential a factor in industrial chemistry. The industrial problems of the chemist and the various methods of solving them are presented to the student by excursions to manufacturing plants as well as by the lectures of the consulting professors, who are in charge of chemical factories.

While the applications of the science to industrial problems are studied in this practical manner, the main emphasis is given to instruction in the science itself, since the elementary knowledge of engineering which is given cannot supply the lack of a thorough knowledge of the fundamental

principles of chemistry. This instruction is identical with that given in the Chemical Course, the amount of time devoted to some of the subjects being slightly reduced, while blow-pipe analysis and mineralogy have been omitted.

For the Freshman year, the requirements are identical with those of the Chemical Course, including rhetoric and debates, Chaucer and the English language, modern English prose, higher algebra and theory of equations, trigonometry, analytical geometry, French or German, drawing, mechanics and heat, and general chemistry.

In the Sophomore year, the outlines of English literature, American politics, recent European history, French or German, electricity and magnetism, sound and light, laboratory physics, machine drawing, differential and integral calculus, and qualitative analysis constitute the subjects of the prescribed courses, while advanced inorganic chemistry is offered as an option.

In the Junior year, the prescribed subjects are political economy, technical English, metallurgy, thermodynamics, mechanics of materials, machine design, industrial chemistry, hydraulics, dynamo electricity, flue, gas and fuel analysis, water and general quantitative analysis. Assaying of gold and silver ore is offered as an option.

In the Senior year, there are given prescribed courses in physical chemistry, steam motors and pumps, water analysis, and organic chemistry. A

thesis must be presented for the degree of Chemical Engineer, embodying the result of a chemical investigation of some industrial process, which has been carried out in the laboratory. Optional courses in electrolysis and electro-synthesis of organic compounds and the chemistry of fabrics are offered.

For a tabulated statement of prescribed subjects of the Course in Chemical Engineering, giving the semesters and number of hours devoted to each, consult pages 90 to 91 inclusive. For a descriptive account of each subject consult pages 123 to 201 inclusive.

III.—Course in Chemistry

The Course in Chemistry is designed for students who intend to become analytical or manufacturing chemists, and is adapted also to the needs of those preparing to become teachers in this science. The instruction is given by lectures and recitations supplemented by laboratory practice. Each student receives personal instruction at his laboratory desk, and in his work is required to make frequent reference to current English and foreign scientific literature. Lectures and recitations are given upon general analytical, industrial, and organic chemistry, and the prescribed studies not purely technical in character are such as have a bearing upon chemical work or are of value as general culture.

Instruction in technical and applied chemistry is supplemented by lectures given by the consulting professors, who are experts in various technical fields. Especial attention is given in these lectures to factory methods and processes and to the industrial problems of distillation, use of fuels, construction of commercial plants, involving operations connected with the performance of chemical operations on a large scale.

It is the aim of the course throughout to give the amplest opportunity for applying in practice the principles laid down in text-books and lectures. In general chemistry, laboratory work be-

gins at once, and the student acquires facility in handling the various forms of apparatus used in preparing gases, acids, salts, and whatever substances he must deal with in order intelligently to pursue the more advanced subjects. The analytical courses present a study of known compounds followed by that of unknown minerals, ores, and rocks, whose elements and their percentage proportions are to be determined. Electro-metallurgy affords practice in the use of the plating cells. The student is confronted with the exact conditions of the successful purification and deposition of copper, nickel, gold, and silver; and the assaying of gold and silver is carried on at the laboratory furnaces. In the organic field, a large number of important substances are prepared; and their purity, properties, and reactions are systematically studied.

Frequent tours of inspection to the manufacturing plants of Greater New York and its vicinity exhibit chemical processes in operation on the most extensive scale, and supplement the laboratory experience of the student. In addition, problems of research are assigned in order to develop the student's ability to prosecute individual investigation, the end sought being to arouse his interest and impart the skill successfully to carry on chemical enterprises with independence and confidence.

Those completing the Chemical Course are

equipped to undertake professional responsibility immediately upon graduation; and the options presented in the Senior year are intended to prepare the student for his chosen department of professional activity.

For the Freshman year the prescribed courses are higher algebra and theory of equations, trigonometry, rhetoric and debating, Chaucer and the English language, modern English prose, analytical geometry, French or German, drawing, mechanics and heat, and general chemistry, with an optional course in oratory.

In the Sophomore year the outlines of English literature, American politics, recent European history, French or German, descriptive geometry, electricity and magnetism, sound, light, laboratory physics, qualitative and blow-pipe analysis constitute the subjects of prescribed courses, and Spanish is offered as an option.

In the Junior year the prescribed subjects are political economy, technical English, quantitative analysis, descriptive and determinative mineralogy, metallurgy, and industrial chemistry.

In the Senior year the prescribed courses are organic and theoretical chemistry, with the thesis investigation; and the optional half-year courses provide specialized study and practice in oil, gas, and water analysis, in medical chemistry, the testing of fabrics, advanced inorganic chemistry, the assaying of gold and silver, electroly-

sis and electro-synthesis of organic compounds, and the determination of molecular weights.

For a tabulated statement of prescribed subjects of the Course in Chemistry, giving the semesters and number of hours devoted to each, consult pages 92 to 93 inclusive. For a descriptive account of each subject consult pages 123 to 201 inclusive.

IV.—Course in Civil Engineering

The course in Civil Engineering is intended to fulfill the requirements of students desiring to enter upon any of its many branches:—Municipal Engineering with its problems of water supply, sewage disposal, and highway construction; Transportation Engineering, including the building of railroads, subways, canals, harbors and docks; Hydraulic Engineering with its questions of water-power development and irrigation; Structural Engineering, comprising the design of bridges, buildings, roofs, foundations and retaining walls.

The subjects comprehended by Civil Engineering, the oldest and broadest of the engineering professions, are so numerous as to prohibit the attempt to cover them all thoroughly in four years, hence the aim of the course is to train the student in the sciences upon which professional practice is based, and to enforce the application of the fundamental principles common to all branches of the profession by extended practice in the drawing room, field, and laboratory. Sufficient attention is given to details and to cost of construction to impress the student with their importance, and to enable him to solve prob-

lems in design with proper regard both to theoretical and practical considerations. Accuracy and neatness in computations and drawings are insisted upon and the student early learns that knowledge unaccompanied by the ability to use it effectively is of little value. The importance of English and the other culture studies which are given throughout the first three years is also emphasized in order that the engineer may not find himself in after life handicapped by the inability to present reports in plain, concise English nor by ignorance of branches of knowledge outside his own profession.

The location of the Polytechnic in the heart of New York City is of great advantage to students in this course since civil engineering projects of the greatest magnitude, involving the expenditure of hundreds of millions of dollars, are now under way, or about to be commenced in the city itself and its immediate surroundings. Subways involving great constructive difficulties are under construction; tunnels under the Hudson and East River are being driven; bridges of enormous span and weight are in process of erection, and an extension of the water supply system upon a scale hitherto unparalleled is soon to be begun. All these enterprises are under the charge of civil engineers, and through their kindness the student is given abundant opportu-

nity to inspect these great undertakings, as well as to visit equally important structures already completed, and thereby to witness on a large scale the practical application of the principles learned in the class room.

In the Freshman year the required work is essentially the same as in the other engineering courses and includes rhetoric, debates, Chaucer and the English language, modern English prose, French or German, trigonometry, higher algebra, general chemistry, mechanics and heat, analytical geometry, mechanical and free-hand drawing.

Professional work is begun in the Sophomore year, when the use of the more common surveying instruments is explained, and facility in their operation acquired by practice in the field. In addition to the professional work instruction is given in American politics, English literature, recent European history, differential and integral calculus, sound and light, electricity and magnetism, physical laboratory, qualitative analysis, descriptive geometry, water analysis, mechanism, and geology.

In the Junior year professional work requires a still larger proportion of the student's time. The strictly professional subjects include theoretical hydraulics, hydraulic laboratory, elementary structures, railroad curves and earthwork, high-

way engineering and advanced surveying. The non-professional subjects required are analytical and applied mechanics, mechanics of materials, testing of materials, thermodynamics, heat and other motors, practical astronomy, technical English, and the law of contracts.

During the vacation following the Sophomore and Junior year the members of these classes are required to attend a summer school of surveying. The location of this school is changed from time to time; the last session was held at Asbury Park, New Jersey. The work done at the school includes triangulation and hydrographic surveying.

The work of the Senior year is purely professional. It includes a thorough course in the theory of structures, and the correlated subject of bridge design, together with courses in public water supplies, sewage disposal, irrigation, pumps and pumping machinery, foundations, and political economy. Thesis work is required in the second semester. The character of the work done in this year is such as to require for its successful completion thorough preparation in the preliminary subjects of the previous years, and no student can hope to take it successfully without such preparation.

For a tabulated statement of prescribed subjects of the Course in Civil Engineering, giving

the semesters and number of hours devoted to each, consult pages 94 to 95 inclusive. For a descriptive account of each subject consult pages 123 to 202 inclusive.

V.—Course in Electrical Engineering

The Course in Electrical Engineering is intended to meet the needs of those students who desire to enter professionally upon the various applications of electricity to the useful arts. Special preparation is afforded those who in after life may be concerned with electric railways, with the telephone, with electro-metallurgy, with electric lighting, generation, transmission, and the utilization of electric power. In shaping the work the aim has been to educate the student in accurate observation, a truthful recording of his observations, the drawing of correct inferences, and the embodiment of his work in concise English, and also to impart such a knowledge of electrical engineering practice as to enable him to enter any of its branches with skill in the manipulation of instruments and machines sufficient to carry on independently the tests and measurements likely to occur in practice. Numerous problems in constructive engineering and designing impress upon him the importance of details, and in these problems working drawings to scale are required whenever necessary. Each candidate for the degree of Electrical Engineer is required to carry out an original investigation and to present a thesis embodying its results—this kind of work being best adapted to develop the

individual resources of the student and to give him confidence in the results obtained.

For the Freshman year prescribed courses are offered in higher algebra and theory of equations, rhetoric, debates, Chaucer and the English language, modern English prose, trigonometry, analytical geometry, French or German, mechanics and heat, shop-work, general chemistry, and mechanical drawing.

In the Sophomore year the outlines of English literature, American politics, recent European history, descriptive geometry, differential and integral calculus, sound, light, electricity and magnetism, electrical measurements, the principles of mechanism, physical laboratory practice, shop-work, qualitative analysis, and machine drawing constitute the subjects of prescribed courses, while courses in French, German and Spanish are offered as options.

In the Junior year political economy, technical English, analytical mechanics, hydromechanics, thermodynamics, heat and other motors, the strength of materials, the testing of materials, dynamo-electricity, quantitative analysis, practice in the dynamo, mechanical, and hydraulic laboratories, shop-work, and machine design are the subjects of prescribed courses.

In the Senior year courses are provided in differential equations, alternating currents, the electric railway, power generation, hydraulic

laboratory, prime motors, heating and ventilating of buildings, the telephone, electro-metallurgy, long distance transmission, framed structures, the law of contracts, electrical design, electric lighting, with practice in the alternating current laboratory, and with thesis work extending through both semesters.

For a tabulated statement of prescribed subjects of the Course in Electrical Engineering, giving the semesters and number of hours devoted to each, consult pages 96 to 97 inclusive. For a descriptive account of each subject consult pages 123 to 201 inclusive.

VI.—Course in Mechanical Engineering

The Course in Mechanical Engineering is designed to prepare the graduate for professional responsibility in the design, erection, and operation of the ordinary types of machinery and motors required for the equipment of factories, railroads, power stations, and large private and public buildings.

During the first two years the student receives a thorough grounding in English, pure mathematics and science, emphasis also being laid upon an early training of the hand and eye in shop-work, sketching, and the interpretation of drawings. The last two years are characterized by courses specially pertaining to mechanical engineering. In addition to the further study of English, the student considers the strength of materials and their proportioning to machines and structures, hydraulics, steam boilers, engines, pumps and turbines, the applications of electricity, metal work, testing of motors, the equipment and sanitation of buildings, the generation and distribution of power, refrigeration, compressed air, oil and gas engines, locomotives, automobiles, political economy, and factory administration. During the Senior year the candidate for the degree of Mechanical Engineer will also conduct an original investigation and present the results in a thesis to be approved by the Faculty.

The instruction is given by text-book, wherever available, and by lectures. Numerous problems are assigned to each student, and abundant examples are cited from the number of engineering enterprises in the neighborhood to which class visits are made. The demonstrations conducted in the laboratory are adjuncts to the class-room work. These tests are made by the student, and while serving as verifications to the theory, are equally valuable in revealing his own limitations. The outside tests, made at stated intervals by the classes in charge of an instructor afford means of ascertaining some of the practical difficulties. The current technical literature is largely drawn upon in class-room discussions, and the Saturday visits of inspection give additional opportunity to keep pace with the progress of the profession. Every effort is made to develop the reasoning faculties of the individual and his sense of proportion.

The special problems to be encountered in practice are impressed upon the student by the conferences with, and courses of evening lectures by, the prominent consulting engineers of the United States. Moreover, all students desiring to continue their technical work during the summer vacations are recommended for remunerative employment in some engineering work suitable to their several capacities. It is believed that with this systematic course of treatment for four years,

the graduate will have acquired such a knowledge of the principles of engineering and skill in manipulation as will give him a modest confidence in his ability to conduct himself creditably in the engineering field.

In the Freshman year English, higher algebra, theory of equations, modern English prose, Chaucer and the English language and debates, trigonometry, analytical geometry, French or German, mechanics and heat, shop-work, general chemistry, and free-hand and mechanical drawing constitute the prescribed courses of study.

In the Sophomore year the outlines of English literature, American political history, recent European history, descriptive geometry, differential and integral calculus, sound and light, electricity and magnetism, electrical measurements, the principles of mechanism, physical laboratory practice, shop-work, qualitative analysis, and machine drawing are pursued in systematic courses.

In the Junior year the courses provide for a study of technical English, political economy, analytical and applied mechanics, hydraulics, thermodynamics, heat and other motors, mechanics of materials, the testing of materials, shop-work, machine design, metallurgy of iron and copper, engineering drawing, gas analysis, boilers and injectors, dynamo electricity, dynamo laboratory, and practice in the mechanical and hydraulic laboratories.

In the Senior year the subjects in the prescribed courses are differential equations, probability and least squares, the law of contracts, foundations, framed structures, architecture, heating and ventilating of buildings, mill design and administration, chimney construction and design, prime motors, pumps and pumping machinery, power generation and distribution, advanced machine design, to which is added the thesis investigation.

For a tabulated statement of prescribed subjects of the Course in Mechanical Engineering, giving the semesters and number of hours devoted to each, consult pages 98 to 99 inclusive. For a descriptive account of each subject consult pages 123 to 201 inclusive.

VII.—Combined Arts and Engineering Courses

For the benefit of those who desire a broader culture than a specialized engineering course of four years can afford, the College offers four combination courses, each of six years' duration, leading to the degree of Bachelor of Arts as well as to the several engineering degrees. Such courses are rendered possible by the number of subjects common to both academic and engineering study and by the fact that many which are essential to an engineering curriculum are proper also to a Course in Arts. Often the Academic student who subsequently undertakes engineering study finds that his training in the common branches has been inadequate to their successful application to engineering work. But where both culture and professional study are under the same guidance, efficiency and economy of time are assured, and the purpose of neither need be sacrificed. Students in these combination courses receive the degree of Bachelor of Arts at the end of four years, and the degree of Chemical, Civil, Electrical or Mechanical Engineer, as the case may be, at the end of two additional years.

The studies of the Freshman and Sophomore years are almost identical with those of the course in Arts, except that the student is not

allowed to elect Latin and Greek, but is required instead to pursue the study of two modern languages. During the Junior and Senior years a few of the more elementary technical subjects are introduced, without interfering with the student's freedom of election from culture subjects, while the fifth and sixth years are identical with the Junior and Senior years of the regular course leading to the engineering degree for which the student is working.

For a tabulated statement of prescribed and elective subjects of each of the four combined Arts and Engineering Courses, giving the semesters and number of hours devoted to each, consult pages 100 to 115 inclusive. For a descriptive account of each subject consult pages 123 to 201 inclusive.

VIII.—Course in Pedagogy

The Course in Pedagogy offered by the Polytechnic aims to furnish to men and women who teach, or intend to become teachers, systematic professional training. It presents a group of studies in philosophy, sociology, and theoretical and applied education which may be taken either (1) independently, or (2) in connection with the regular work of the Course in Arts as leading to the degree of Bachelor of Arts, or (3) by such as already hold the Baccalaureate degree in partial fulfillment of requirements for the degree of Master of Arts.

To those pursuing the course (1) independently or for promotion in the schools, certificates will be issued on the completion of each subject. For those (2) studying for the Bachelor's degree, these subjects alone will satisfy thirty-six semester hours of Junior and Senior work, or practically all Junior and Senior requirements. To complete the Arts Course remaining hours must be picked from electives and prescribed studies tabled on pages 84 to 89. (3) Candidates for the degree of Master of Arts may submit these courses as constituting one major or one major and one minor subject, according to the requirement for the Master's Degree formulated on page 72; and should further select two minor subjects or one minor subject, as the case may be,

from the departments of English, Comparative literature, history, political and social science, Greek, Latin, French, German, Spanish, Italian, chemistry, physics, mathematics, civil, electrical, or mechanical engineering.

The subjects of the Course in Pedagogy are described under the several departments which offer them, as follows: logic, psychology, educational psychology, ancient and mediæval philosophy, modern philosophy, and ethics under the Department of Philosophy; sociology under the Department of Social and Political Science; the history of education, principles of education, philosophy of education, educational masterpieces, school organization and administration, general methods, curriculum and methods of elementary school teaching, and special methods of teaching under the Department of Education.

For the benefit of teachers who may be engaged at other hours, these subjects of the Course in Pedagogy are given as a rule at four o'clock in the afternoon, eight in the evening or ten on Saturday mornings, the particular distribution of hours and subjects being left to be determined by the convenience of those who apply for courses. All applications for entrance to courses should be addressed to the Registrar, College of Arts and Engineering, Polytechnic Institute of Brooklyn, Brooklyn, New York, on or before June 12th, 1907; October 8th, 1907; February

10th, 1908; or June 10th, 1908. Such applications should be accompanied by certificates of work done within the class-rooms of other colleges, in summer schools, and in teaching, if a professional certificate or a degree is sought.

TEACHERS' LICENSES.

The following subjects compose the required Pedagogical Course which leads directly to examination for State and City Licenses for Teachers: logic, psychology, general methods of teaching, curriculum and methods of elementary school teaching, special methods, history of education, principles of education, and philosophy of education.

The State Department of Public Instruction grants professional certificates for teachers on the following conditions:

1. The candidate must have pursued a regular Course in Arts, Philosophy or Science, and be entitled to the degree of A.B., Ph.B., or B.S.;

2. He must have successfully completed the pedagogical work required—*i. e.*, logic, psychology, history of education and philosophy, and principles of education;

3. Before graduation he must pass the elementary examinations required by the State authorities;

4. And he must demonstrate teaching ability.

Secondary School Licenses require the following: (1) completion of the regular Sophomore work of the Course in Arts; (2) special courses in psychology, educational psychology, history of education, principles of education, ethics, and general and special methods. Three hours a week for three years, or two hundred and seventy hours, are required in all diploma subjects.

Elementary School Licenses require (1) the completion of regular Sophomore work of the Course in Arts or graduation from Normal or Teachers' Training School, with (2) Courses in general and special methods.

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Students otherwise qualified to apply for licenses to teach in New York City, who complete certain courses in the College of Arts and Engineering may be exempted in part from examinations for certain of their licenses, viz.: license for promotion, license as assistant to principal, and license as principal in elementary schools.

For information respecting the exemptions to be secured, and the scope and character of examinations for teachers' licenses, application should be made to the office of the City Superintendent of Schools, Park Avenue and Fifty-ninth Street, New York, N. Y.

For a tabulated statement of prescribed and elective subjects of the General Course in Ped-

agogy and the License Course in Pedagogy, giving the course numbers and the aggregate number of hours devoted to each, consult pages 116 to 117 inclusive. For a complete account of each subject consult pages 123 to 201 inclusive.

IX.—Graduate Course in Arts

Upon the completion of a year's course of graduate study pursued under the approval of the Faculty and in residence, the degree of Master of Arts is conferred upon candidates possessing the degree of Bachelor of Arts from the Polytechnic Institute or any institution of equal rank. Each candidate for the degree of Master of Arts is required to elect one major and two minor groups of subjects from a list of graduate studies, and he must devote at least one-half of his time to the major group under the direction of the professor in charge of that department, and one-half of his time to his minor subjects. To complete the required course an extensive thesis upon some subject connected with the student's major group must be submitted and approved.

The candidate for the degree of Master of Arts should select his major group of subjects from one of the following departments: Education, English and Comparative Literature, French, German, Greek, History, Latin, Mathematics, Philosophy, or Political and Social Science. A first minor subject or group of subjects should be taken from these departments or from those of Italian and Spanish; and a second minor subject or group of subjects should be taken either from the above departments or from the departments of Chemistry and Chemical Engineering, Civil,

Electrical, and Mechanical Engineering, and Physics. The minimum requirement for a major subject is four hours a week of lectures both semesters, exclusive of such lecture hours as may be devoted to the thesis; and the minimum for each of the two minor courses is two hours a week of lecture both semesters, for one year. The minimum requirement, therefore, of class work for the degree of Master of Arts is two hundred and forty lecture hours, two hours of laboratory counting as one hour of lecture.

For a tabulated statement of Graduate Studies, giving the aggregate number of hours devoted to each, consult pages 118 to 121 inclusive. For a descriptive account of each subject consult pages 123 to 201 inclusive, where in each department courses open to graduates and undergraduates and to graduates only follow the subjects listed for undergraduates only.

X.—Graduate Course in Science

Upon the completion of a year's course of graduate study pursued under the approval of the Faculty and in residence, the degree of Master of Science is conferred upon candidates possessing the degrees of Bachelor of Science, Civil, Electrical, or Mechanical Engineer, from the Polytechnic Institute or any institution of equal rank. Each candidate for the degree of Master of Science is required to elect one major and two minor groups of subjects from a list of graduate studies, and he must devote at least one-half of his time to the major group under the direction of the professor in charge of that department, and one-half of his time to his minor subjects. To complete the required course an extensive thesis upon some subject connected with the student's major group must be submitted and approved.

The candidate for the degree of Master of Science should select his major group of subjects from one of the following departments: Mathematics, Chemistry and Chemical Engineering, Civil, Electrical, and Mechanical Engineering. A first minor subject or group of subjects should be taken from these departments or from that of Physics; and a second minor subject or group of subjects should be taken either from the above departments or from the departments of Educa-

tion, English and Comparative Literature, French, German, Greek, History, Italian, Latin, Philosophy, Political and Social Science, or Spanish. The minimum requirement for a major subject is six hours a week of lectures both semesters, exclusive of such lecture hours as may be devoted to the thesis; and the minimum for each of the two minor courses is three hours a week of lectures both semesters, for one year. The minimum requirement, therefore, of class work for the degree of Master of Science is three hundred and sixty lecture hours, two hours of laboratory counting as one hour of lecture.

For a tabulated statement of Graduate Studies, giving the aggregate number of hours devoted to each, consult pages 118 to 121 inclusive. For a descriptive account of each subject consult pages 123 to 201 inclusive, where in each department courses open to graduates and undergraduates and graduates only follow the subjects listed for undergraduates only.

XI.—Evening Courses in Chemistry and Engineering

The College offers a series of evening courses in the departments of Chemistry, Chemical, Civil, Electrical, and Mechanical Engineering, and in the department of Mathematics to be pursued either separately or as leading to the proper academic or professional degrees. These courses are conducted by means of lectures, recitations, and discussions given under the direction of members of the regular departments of the College, and are open to all persons who are qualified to take them. They are especially designed to meet the requirements of those engaged in chemistry and engineering and allied professions, who may be desirous of continuing the study of the theoretical principles involved, or of conducting investigations in some particular field.

Students of such courses enjoy the advantage of instruction by a board of Consulting Professors who are engineers in actual practice and eminent specialists in their respective lines. Their work is an essential part of the course, dealing with actual professional practice. It is similar to the professional instruction given in medical colleges by eminent practising physicians and surgeons. The student is required to make reports in engineering form upon supposititious engineering problems. Thus, he acquires from the

best masters the most approved professional habits of thought and expression.

For a detailed description of evening courses in Chemistry and Engineering consult pages 205 to 215 inclusive. The evening courses in Mathematics are listed under the Courses for Teachers at page 225.

XII.—Courses for Teachers

1. For the benefit of teachers and other mature persons, the College of Arts and Engineering offers afternoon, evening, and Saturday morning class-exercises in the prescribed studies of the Course in Arts, to be taken either as leading to the Bachelor's degree in Arts or without reference to it. These courses are open to both men and women and are conducted by means of lectures, discussions, and reports. In general, they seek to encourage the expression of the individual and to avoid the impersonality incident to large numbers. With this end in view, no more than twenty are admitted to a class, except in certain specified instances. The College reserves the right to withdraw any course for which the number of registrations is deemed insufficient.

2. No formal examinations for entrance are required of those not seeking a degree, although secondary school preparation is assumed. Candidates for a degree in the Courses for Teachers should present themselves for admission (a) by taking the regular entrance examinations in June, September, or February, or (b) by submitting to the judgment of the Faculty appropriate credentials for scholastic work already done. Properly authenticated certificates of work done in Summer Schools will be accepted, provided they be

issued and guaranteed by a college or university of high standing.

Certain exemptions from examinations for entrance or in course are allowed, as follows :

a. No entrance examination is required of graduates of New York City High Schools or other High Schools of equal rank, approved by the Faculty.

b. No entrance examination in history, physiology or mathematics is required of teachers of three years' experience in the High Schools of New York City, or teachers who have taught three years in the Public Schools of New York under a Grade A certificate.

c. No entrance examination in English (other than composition) is required of teachers who have been three years in active service.

d. Examinations in Course are optional for auditors or students who are not candidates for a certificate or a degree.

Applications for admission upon certificate to candidacy for a degree should be made to the Faculty through the Registrar on or before June 12th or October 8th, 1907 ; February 10th or June 10th, 1908, and all applications for entrance to courses should be filed with the Registrar, Room 2, 85 Livingston Street, Brooklyn, on or before these dates. Opportunity will be given those applying for entrance to any course to indicate the day of the week and the hour preferred for taking

it, and a schedule to accommodate the majority will then be submitted to all applicants.

3. In accordance with the terms of the circular issued by the City Superintendent of Schools, under date of June 24, 1898, and specifying the requirements for a teachers' license No. 2, or Grade A, and for Head of Department licenses, the courses of instruction offered by the College in its various departments present to teachers a favorable opportunity for performing the work necessary in order to obtain either one of those certificates. For these purposes the City Superintendent approves all college classes except those which may be engaged upon the elementary study of a language. Certain exemptions from examinations are also allowed, information concerning which may be had by applying to the office of the City Superintendent of Schools, Park Avenue and Fifty-ninth Street, New York, N. Y.

4. Candidates for a degree must complete the required curriculum of the Course in Arts, which allows, however, of specialization in Pedagogy if so desired (see pages 67 and 71), and must either (a) devote one scholastic year to study in the College or (b) complete in the College not less than eight residence courses. At the discretion of the Faculty, however, the rule requiring eight residence courses may be modified, in the case of students admitted upon letters of honorable dismissal from other colleges.

5. To facilitate the work of instruction and for the convenience of societies, clubs, schools, teachers' associations or other organizations desirous of pursuing courses as a body, arrangements have been made to offer instruction under the joint auspices of the society and the College, such courses to be given either at the College or away from it. All courses offered elsewhere must be paid for at the rate of \$10.00 per lecture hour, exclusive of the lecturer's traveling expenses and the cost of the lecture hall.

6. Other fees for the Courses for Teachers are proportionate to the total number of hours in each course, irrespective of the length of single sessions, which may vary from one hour to an hour and a half or two hours, according to the nature of the subject and the convenience of the class.

The regular charge for these courses follows :

For the first 100 hours. .\$.40 per hour

From 100 to 200 hours. . .35 per hour

From 200 to 300 hours. . .30 per hour

All fees are payable in advance, and the Registrar on receipt of the proper amount will issue a ticket of admittance to each class to be presented to the instructor in charge.

There are no fees for matriculation or examination, but in the Courses for Teachers a fee

of \$10 is charged candidates for a degree at graduation.

7. For further information as to license requirements for teachers consult the section devoted to the Course in Pedagogy at page 67; and for a descriptive account of subjects offered in the Courses for Teachers and the aggregate hours of each consult pages 215 to 231 inclusive.

Schedules of Courses

By Subjects and Semesters or by Total Hours

In the following Schedules, from I to VII inclusive, the figure preceding each subject indicates the average number of hourly sessions a week during one semester devoted to that study; and the figure following each subject indicates the number of that course as described in the table of Departments and Subjects of Instruction, pages 123 to 201 inclusive.

It will be observed that the Freshman years of all these courses are very much alike, those of the four-year scientific courses being practically identical. It is possible, therefore, for any student entered upon a given course to change to another course for which he finds himself better adapted if the transfer be made not later than the opening of the Sophomore year. But when undertaken during or after the Sophomore year a change of course entails loss of time and additional work.

Schedules VIII, IX, and X for students of Pedagogy and Graduate Students give the total number of hours devoted to each subject, its course number and the number of the page at which it is described.

I.—COURSE IN ARTS

NOTE.—Students who at entrance have successfully presented either Higher Algebra, Solid Geometry, or Chemistry, may omit such subject or subjects and substitute therefor optional studies of the Freshman year or, with the President's approval, any available Sophomore studies. A minimum of 18 hours, however, will be required.

Additional optional studies taken during Freshman and Sophomore years may be counted toward fulfilling the Elective requirements of later years, provided they be found listed as Junior or Senior Electives.

FRESHMAN YEAR

18 HOURS REQUIRED

18 HOURS REQUIRED

Hours a week	First Semester	Course Number	Hours a week	Second Semester	Course Number
2	Principles of Rhetoric....	160	1	Debates	167
2	Chaucer and the English Language	175	3	Modern English Prose and Composition	161
2	Higher Algebra.....	322	3	Shakespeare	177
2	Solid Geometry	320	3	Mediaeval History.....	260
2	Trigonometry	321	3	General Chemistry	40
3	General Chemistry	40	Two Language Courses		
3	a. Latin,—Cicero	300	3	a. Latin,—Livy	301
3	b. Greek,—Xenophon or Lysias.....	240	3	b. Greek,—Homer.....	241
3	c. 19th Century French, or Classical French..	202	2	c. 19th Century French or Classical French..	200
3	d. Introductory German or Modern German Prose	220	2	d. Introductory German or Classical French..	202
2		222	3	d. Introductory German or Modern German Prose	220
			3		222

OPTIONAL STUDIES

3	Free Hand Drawing.....	22	3	Free Hand Drawing.....	22
3	Chemical Laboratory.....	40	3	Chemical Laboratory.....	40
3	Carpentry.....	378	1	Oratory	166
3	Elementary Spanish.....	470	2	Theory of Equations.....	323
2	Zoölogy.....	400	5	Analytical Geometry.....	324
			3	Carpentry and Foundry work	378
			3	Elementary Spanish.....	470
			2	Geology	401

SOPHOMORE YEAR

17 HOURS REQUIRED

17 HOURS REQUIRED

Hours a week	First Semester	Course Number	Hours a week	Second Semester	Course Number
2	English Literary Epochs.	176	2	English Literary Epochs.	176
3	Literature from Spenser to Pope.....	178	3	18th Century Literature..	179
3	History of Modern Europe	261	3	One History Course	
3	Electricity and Magnet- ism.....	431	3	a. History of Renais- sance.....	263
	Two Language Courses		3	b. History of France....	264
3	a. Latin,—Tacitus, Pliny	302	3	c. History of England..	265
3	b. Greek,—Demosthe- nes.....	242	3	Sound and Light.....	432
3	c. Classical French, <i>or</i>	202	3	Two Language Courses	
2	Outlines of French		3	a. Latin,—Horace.....	303
	Literature.....	203	3	b. Greek,—Theocritus and Aristophanes..	243
2	d. Modern German		2	c. Classical French, <i>or</i>	202
	Prose, <i>or</i>	222	3	Outlines of French	
3	Outlines of German		3	Literature.....	203
	Literature.....	223	3	d. Modern German	
				Prose, <i>or</i>	222
			2	Outlines of German	
				Literature.....	223

OPTIONAL STUDIES

3	Free-hand Drawing.....	22	3	Free-hand Drawing.....	22
3	Differential Calculus.....	325	2	Theory of Equations.....	323
5	Qualitative Analysis.....	42	3	Integral Calculus.....	326
2	Mechanics and Heat.....	430	5	Analytical Geometry....	324
2	History of Education....	100	3	Descriptive Geometry....	327
3	Carpentry.....	378	2	Mechanics and Heat.....	430
3	Elementary Spanish.....	470	3	Carpentry and Foundry- work.....	378
2	Zoölogy.....	400	3	Elementary Spanish.....	470
3	Elementary Surveying...	70	2	Geology.....	401
			3	Psychology.....	411
			1	Oratory.....	166

JUNIOR YEAR

PRESCRIBED STUDIES

9 HOURS REQUIRED

7 HOURS REQUIRED

Hours a week	First Semester	Course Number	Hours a week	Second Semester	Course Number
3	19th Century Literature..	180	3	Psychology	411
2	American Political History	268	2	Logic.....	410
2	Political Economy.....	450	2	One Language Course....	
2	One Language Course...		2	a. Latin,—Plautus and Terence	304
2	a. Latin,—Plautus and Terence	304	2	b. Greek,—Aeschylus, Sophocles and Plato	244
2	b. Greek,—Aeschylus, Sophocles and Plato	244	2	c. Mediaeval French <i>or</i> Outlines of French Literature.....	204
2	c. Mediaeval French <i>or</i> Outlines of French Literature	204	2	d. Early German, <i>or</i> Outlines of German Literature.....	203
2	d. Early German, <i>or</i> Outlines of German Literature	203	2	e. Elementary Spanish.	224
3	e. Elementary Spanish.	224	3		223
2		223			470
3		470			

JUNIOR YEAR

ELECTIVE STUDIES

7 HOURS TO BE SELECTED

9 HOURS TO BE SELECTED

Hours a week	First Semester	Course Number	Hours a week	Second Semester	Course Number
2	Science of Language.....	190	2	American Political His- tory	268
2	Old English.....	186	2	Middle English.....	185
3	American Literature.....	184	3	Literary Criticism.....	192
1	Argumentative Composi- tion	163	3	English Romantic Move- ment	182
1	Advanced Oratory.....	168	3	Tennyson and Browning.	183
3	The English Novel.....	181	1	Advanced Oratory.....	168
2	History of Art	20	3	History of Renaissance..	263
3	Descriptive Astronomy..	77	3	History of France	264
2	Laboratory Physics.....	433	3	History of England.....	265
2	History of Education....	100	3	History of Art	20
2	Principles of Education..	101	2	Practical Astronomy....	78
1	Educational Masterpieces	103	2	Laboratory Physics.....	433
5	Qualitative Analysis.....	42	2	Finance	451
2	Zoölogy.....	400	3	Sociology	452
2	General Botany.....	402	3	Architecture.....	21
2	Mechanics and Heat.....	430	2	Geology	401
2	Advanced Free-hand Drawing	25	3	Industrial and Economic Botany.....	403
3	Latin,—Cicero	300	2	Mechanics and Heat....	430
3	Latin,—Tacitus and Pliny	302	2	Advanced Free-hand Drawing	25
2	Latin,—Plautus and Ter- ence	304	3	Latin,—Livy	301
3	Greek,—Xenophon or Ly- sias.	240	3	Latin,—Horace	303
3	Greek,—Demosthenes....	242	2	Latin,—Plautus and Ter- ence	304
2	Greek,—Aeschylus, Soph- ocles and Plato	244	3	Greek,—Homer	241
2	Outlines of French Litera- ture	203	3	Greek,—Theocritus and Aristophanes.....	243
2	Mediaeval French.....	204	2	Greek,—Aeschylus, Soph- ocles and Plato	244
3	Outlines of German Lit- erature	223	3	Outlines of French Liter- ature.....	203
2	Early German.....	224	2	Mediaeval French.....	204
2	Educational Psychology.	412	2	Outlines of German Lit- erature.....	223
1	General Methods of Teaching	105	1	Educational Masterpieces	103
3	Elementary Spanish.....	470	1	General Methods of Teaching.....	105
3	Spanish Literature.....	471	2	Early German.....	224
3	Elementary Italian.....	290	3	Elementary Spanish.....	470
3	Differential Calculus....	325	3	Spanish Literature.....	471
2	Differential Equations...	329	3	Elementary Italian.....	290
3	Carpentry	378	3	Integral Calculus.....	326
3	Forging	379	3	Descriptive Geometry...	327
3	Testing Materials.....	83	3	Carpentry and Foundry- work.....	378
3	Mechanics of Materials..	82	3	Chipping and Filing	380
2	Heat and other Motors...	366	3	Dynamo Electricity	131
5	Mechanical Drawing.....	23			
2	Thermodynamics.....	365			
3	Alternating Currents....	133			

SENIOR YEAR

PRESCRIBED STUDIES

3 HOURS REQUIRED

3 HOURS REQUIRED (Thesis Extra)

Hours a week	First Semester	Course Number	Hours a week	Second Semester	Course Number
3	History of Ancient and Mediaeval Philosophy..	415	3	Ethics Thesis; see page 44.	413

ELECTIVE STUDIES

13 HOURS TO BE SELECTED

13 HOURS TO BE SELECTED

3	Comparative Study of Literary Types.....	191	3	Comparative Study of Literary Types.....	191
1	Literary Forms.....	164	2	Middle English.....	185
2	Science of Language....	190	3	Literary Criticism.....	192
2	Old English.....	186	3	English Romantic Move- ment.....	182
3	American Literature.....	184	3	Tennyson and Browning.	183
3	The English Novel.....	181	1	Advanced Oratory.....	168
1	Argumentative Composi- tion.....	163	3	History of Renaissance..	263
2	History of Art.....	20	3	History of France.....	264
2	Laboratory Physics.....	433	3	History of England.....	265
2	Educational Psychology.	412	2	Educational Masterpieces	103
2	History of Education	100	2	Educational Administra- tion.....	104
3	Principles of Education..	101	1	General Methods of Teaching.....	105
1	General Methods of Teaching.....	105	3	Modern Philosophy.....	416
3	Descriptive Astronomy..	77	3	Practical Astronomy....	78
2	Zoölogy.....	400	2	Geology.....	401
2	General Botany.....	402	3	Industrial or Economic Botany.....	403
2	Mechanics and Heat.....	430	2	History of Art.....	20
3	Special Topics in United States History.....	269	3	Architecture.....	21
2	Aesthetics.....	414	3	Finance.....	451
1	Advanced Oratory.....	168	3	Sociology.....	452
2	Advanced Free-hand Drawing.....	25	2	Mechanics and Heat	430
3	Comparative Constitu- tional Law.....	453	2	Advanced Free-hand Drawing.....	25
			3	International Law.....	454

(Continued on next page)

SENIOR YEAR

ELECTIVE STUDIES

(Continued from preceding page)

Hours a week	First Semester	Course Number	Hours a week	Second Semester	Cour se Number
3	Latin,—Tacitus and Pliny	302	3	Latin,—Horace	303
2	Latin,—Plautus and Terence.....	304	2	Latin,—Plautus and Terence.....	304
3	Greek,—Demosthenes....	242	3	Greek,—Theocritus and Aristophanes	243
2	Greek,—Aeschylus, Sophocles and Plato.....	244	2	Greek,—Aeschylus, Sophocles and Plato.....	244
2	Outlines of French Literature.....	203	3	Outlines of French Literature.....	203
2	Mediaeval French.....	204	2	Mediaeval French.....	204
3	Outlines of German Literature.....	223	2	Outlines of German Literature.....	223
2	Early German.....	224	2	Early German.....	224
3	Elementary Spanish.....	470	2	Elementary Spanish.....	470
3	Spanish Literature	471	3	Spanish Literature	471
3	Elementary Italian.....	290	3	Elementary Italian.....	290
2	Dante.....	291	2	Dante.....	291
3	Differential Calculus.....	325	2	Integral Calculus.....	326
5	Mechanical Drawing.....	23	3	Descriptive Geometry....	327
2	Differential Equations...	329	2	Analytical Mechanics	328
3	Machine-work	381	3	Tool-making.....	379
1	Philosophy of Education.	102	1	Philosophy of Education.	102
1	School Organization and Administration	104	1	School Organization and Administration.....	104
2	Quantitative Analysis....	45	1	Telephone, Telegraphy Patent Practice.....	135
2	Heat and other Motors....	366	2	Electric Lighting	139
2	Thermodynamics..	365	1	Central Station Practice..	141
3	Testing Materials.....	83	2	Foundations	80
2	Heating and Ventilation.	371	2	Special Methods of Teaching	107
4	Framed Structures.....	84			
2	Curriculum and Methods of Elementary School Teaching	106			
5	Analytical Mechanics.....	328			

II.—CHEMICAL ENGINEERING COURSE *

FRESHMAN YEAR

Hours a week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Principles of Rhetoric....	160	3	Modern English Prose and Composition.....	161
2	Chaucer and the English Language	175	1	Debates	167
	One Language Course:			One Language Course:	
2	a. Scientific French <i>or</i> ..	201	3	a. Scientific French <i>or</i> ..	201
3	b. Classical French <i>or</i> ..	202	2	b. Classical French <i>or</i> ..	202
3	c. Scientific German <i>or</i> ..	221	2	c. Scientific German <i>or</i> ..	221
2	d. Modern German Prose	222	3	d. Modern German.....	222
3	Trigonometry	321	5	Analytical Geometry....	324
3	Higher Algebra	322	2	Theory of Equations.....	323
6	General Chemistry.....	40	2	Mechanics and Heat.....	430
2	Mechanics and Heat.....	430	6	General Chemistry.....	40
5	Mechanical Drawing.....	23	5	Object Drawing.....	24

SOPHOMORE YEAR

2	English Literary Epochs.	176	2	English Literary Epochs.	176
2	Recent European History	262	2	American Politics.....	267
3	Electricity and Magnet- ism.....	431	3	Sound and Light	432
2	Laboratory Physics.....	433	3	Laboratory Physics.	433
3	Classical French <i>or</i>	202	2	Classical French <i>or</i>	202
2	Modern German Prose..	222	3	Modern German Prose..	222
12	Qualitative Analysis.....	41	3	Integral Calculus	326
5	Machine Drawing.....	360	15	Qualitative Analysis.....	41
3	Differential Calculus	325	2	Advanced Inorganic Chemistry (<i>Optional</i>)....	56

* In the schedule for this course no distinction is made between lecture and laboratory hours, the sum of both being given.

JUNIOR YEAR

Hours a week	First Semester	Course Number	Hours a week	Second Semester	Course Number
2	Political Economy	450	1	Technical English.....	162
1	Technical English.....	162	5	Machine Design.....	363
5	Metallurgy.....	47	2	Industrial Chemistry....	46
2	Industrial Chemistry....	46	3	Dynamo Electricity.....	131
3	Hydraulics.....	375	1	Dynamo Laboratory.....	132
2	Thermodynamics	365	2	Fuel and Gas Analysis....	50
3	Mechanics of Materials...	82	16	Quantitative Analysis....	44
20	Quantitative Analysis....	44	6	Assaying of Gold and Silver Ores (<i>Optional</i>).....	57

SENIOR YEAR

2	Physical Chemistry.....	48	5	Water Analysis.....	53
3	Hydraulic Laboratory....	375	21	Organic Chemistry.....	49
15	Organic Chemistry.....	49	15	Thesis	64
15	Thesis	64	2	Thermo Chemistry.....	52
6	Electrolysis and Electro-Synthesis of Organic Compounds.....	58	6	Chemistry of Fabrics (<i>Optional</i>).....	55

III.—COURSE IN CHEMISTRY *

FRESHMAN YEAR

Hours a Week	First Semester.	Course Number	Hours a Week	Second Semester	Course Number
2	Principles of Rhetoric....	160	3	Modern English Prose and Composition.....	161
2	Chaucer and the English Language.....	175	1	Debates	167
	One Language Course:			One Language Course:	
2	a. Scientific French, <i>or</i> ..	201	3	a. Scientific French, <i>or</i> ..	201
3	b. Classical French, <i>or</i> ..	202	2	b. Classical French, <i>or</i> ..	202
3	c. Scientific German, <i>or</i>	221	2	c. Scientific German, <i>or</i>	221
2	d. Modern German Prose.....	222	3	d. Modern German.....	222
3	Trigonometry	321	5	Analytical Geometry	324
2	Higher Algebra.....	322	2	Theory of Equations.....	323
6	General Chemistry.....	40	6	General Chemistry.....	40
2	Mechanics and Heat.....	430	2	Mechanics and Heat	430
5	Mechanical Drawing.....	23	5	Object Drawing.....	24

SOPHOMORE YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Recent European History	262	2	English Literary Epochs.	176
2	English Literary Epochs.	176	2	American Politics.....	276
3	Electricity and Magnet- ism.....	431	3	Sound and Light	432
2	Laboratory Physics.....	433	2	Laboratory Physics.....	433
2	Classical French, <i>or</i> ... }	202	2	Classical French, <i>or</i> ... }	202
2	Modern German Prose. }	222	3	Modern German Prose. }	222
6	Blowpipe Analysis.....	43	18	Qualitative Analysis.....	41
12	Qualitative Analysis.....	41			

* In the schedule for this course no distinction is made between lecture and laboratory hours, the sum of both alone being given.

JUNIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
1	Technical English.....	162	1	Technical English.....	162
2	Political Economy	450	4	Determinative Mineral-	
4	Descriptive Mineralogy..	404	4	ogy	405
5	Metallurgy.....	47	3	Industrial Chemistry....	46
20	Quantitative Analysis....	44	23	Quantitative Analysis....	44
			3	Water Analysis.....	53

SENIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Theoretical and Physical Chemistry.....	48	21	Organic Chemistry.....	49
15	Organic Chemistry.....	49	2	Thermo-Chemistry	52
15	Thesis	64	15	Thesis	64

OPTIONAL STUDIES FOR SPECIALIZATION

6	Oil and Gas Analysis.....	51	6	Chemistry of Fabrics....	55
6	Medical Analysis.....	54	6	Assaying of Gold and Silver.....	57
2	Advanced Inorganic Chemistry.....	56	6	Determination of Mole- cular Weights	59
6	Electrolysis and Electro- Synthesis of Organic Compounds.....	58			

IV.—COURSE IN CIVIL ENGINEERING

FRESHMAN YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Principles of Rhetoric....	160	3	Modern English Prose	
2	Chaucer and the English			and Composition.....	161
	Language.....	175	1	Debates.....	167
	One Language Course:			One Language Course:	
2	a. Scientific French, <i>or.</i>	201	3	a. Scientific French, <i>or.</i>	201
3	b. Classical French, <i>or.</i>	202	2	b. Classical French, <i>or.</i>	202
3	c. Scientific German, <i>or.</i>	221	2	c. Scientific German, <i>or.</i>	221
2	d. Modern German		3	d. Modern German	
	Prose.....	222		Prose.....	222
3	Trigonometry.....	321	5	Analytical Geometry.....	324
2	Higher Algebra.....	322	2	Theory of Equations.....	323
6	General Chemistry.....	40	6	General Chemistry.....	40
2	Mechanics and Heat.....	430	2	Mechanics and Heat.....	430
2	Mechanical Drawing.....	23	1	Free-hand Drawing.....	26
2	Free-Hand Drawing.....	26	5	Mechanical Drawing.....	23

SOPHOMORE YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	English Literary Epochs.	176	2	English Literary Epochs.	176
2	Recent European History	262	2	American Politics.....	267
3	Differential Calculus.....	325	3	Descriptive Geometry...	327
5	Qualitative Analysis.....	42	3	Integral Calculus.....	326
3	Electricity and Magnet-		3	Sound and Light.....	432
	ism.....	431	2	Laboratory Physics.....	433
2	Laboratory Physics.....	433	2	Topographical Drawing..	74
8	Surveying and Plotting..	70	3	Water Analysis.....	53
2	Geology.....	401	2	Mechanism.....	361
			6	Surveying and Plotting..	70
SUMMER SCHOOL, COURSE 73					

JUNIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
1	Technical English.....	162	1	Technical English.....	162
5	Analytical and Applied Mechanics.....	328	2	Analytical and Applied Mechanics	328
3	Mechanics of Materials...	82	2	Theory of Structures....	77
3	Testing Materials.....	83	3	Heat and other Motors...	366
3	Thermodynamics	365	3	Hydraulics.....	372
3	Heat and other Motors...	366	3	Hydraulic Laboratory...	374
2	Railroad Curves and Earthwork.....	71	2	Practical Astronomy....	78
6	Railroad Survey and Drawing	72	2	Railroad Curves and Earthwork	71
			4	Highway Engineering....	89
				Advanced Surveying....	76
SUMMER SCHOOL, COURSE 73					

SENIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Political Economy.....	450	1	Foundations.....	80
1	Law of Contracts.....	79	4	Theory of Structures....	81
1	Theory of Structures....	81	6	Bridge Design	85
6	Bridge Design.....	85	4	Sewage and Irrigation..	87
4	Public Water Supplies....	86	6	Sanitary and Hydraulic Design.....	88
2	Pumps and Pumping Machinery	373	8	Thesis	90
2	Hydraulic Measurements	75			

V.—COURSE IN ELECTRICAL ENGINEERING

FRESHMAN YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Principles of Rhetoric....	160	3	Modern English Prose	
2	Chaucer and the English Language	175	1	and Composition.....	161
	One Language Course:			Debates.....	167
2	a. Scientific French, <i>or.</i>	201	3	One Language Course:	
3	b. Classical French, <i>or.</i>	202	2	a. Scientific French, <i>or.</i>	201
3	c. Scientific German, <i>or.</i>	221	2	b. Classical French, <i>or.</i>	202
2	d. Modern German		3	c. Scientific German, <i>or.</i>	221
	Prose.....	222		d. Modern German	
3	Trigonometry.....	321	5	Prose	222
2	Higher Algebra.....	322		Analytical Geometry....	324
6	General Chemistry.....	40	6	Theory of Equations....	323
2	Mechanics and Heat.....	430	2	General Chemistry.....	40
5	Mechanical Drawing.....	23	2	Mechanics and Heat.....	430
3	Carpentry.....	378	5	Mechanical Drawing.....	23
			3	Carpentry and Foundry- work.....	378

SOPHOMORE YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	English Literary Epochs.	176	2	English Literary Epochs.	176
2	Recent European History	262	2	American Politics.....	267
3	Differential Calculus	325	3	Descriptive Geometry...	327
5	Qualitative Analysis.....	42	3	Integral Calculus.....	326
3	Electricity and Magnet- ism.....	431	3	Sound and Light	432
5	Machine Drawing.....	360	6	Electrical Measurements.	434
2	Laboratory Physics.....	433	5	Principles of Mechanism.	361
3	Forging.....	379	2	Laboratory Physics.....	433
			3	Chipping and Filing	380

JUNIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
1	Technical English.....	162	1	Technical English.....	162
2	Political Economy	450	2	Analytical and Applied Mechanics	328
5	Analytical and Applied Mechanics	328	3	Dynamo Electricity.....	131
2	Quantitative Analysis....	45	6	Dynamo Laboratory.....	132
3	Mechanics of Materials...	82	3	Hydraulics.....	372
3	Testing Materials.....	83	3	Hydraulic Laboratory...	375
3	Mechanical Laboratory...	367	5	Elementary Machine De- sign	363
2	Thermodynamics	365	3	Heat and other Motors ...	366
3	Heat and other Motors....	366	3	Tool-making	381
1	Materials of Electric Con- struction	130			
3	Machine-work.....	381			

SENIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Differential Equations....	329	1	Telephony, Telegraphy and Patent Practice....	135
1	Law of Contracts.....	79	1	Electric Traction.....	136
3	Framed Structures	84	1	Electrical Power Trans- mission	137
3	Power Generation and Distribution	370	2	Electrical Design	138
2	Metallurgy of Iron and Copper.....	47	2	Electric Lighting.....	139
3	Alternating Currents....	133	15	Thesis	142
9	Alternating Current Lab- oratory	134			
2	Electrical Design.....	138			
10	Thesis	142			
1	Central Station Practice..	141			
½	Commercial Electrical Engineering	140			

VI.—COURSE IN MECHANICAL ENGINEERING

FRESHMAN YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Principles of Rhetoric....	160	3	Modern English Prose and Composition.....	161
2	Chaucer and the English Language.....	175	1	Debates ..	167
	One Language Course :			One Language Course :	
2	a. Scientific French, <i>or</i> .	201	3	a. Scientific French, <i>or</i> .	201
3	b. Classical French, <i>or</i> .	202	2	b. Classical French, <i>or</i> .	202
2	c. Scientific German, <i>or</i> .	221	2	c. Scientific German, <i>or</i> .	221
3	d. Modern German Prose	222	3	d. Modern German Prose	222
3	Trigonometry	321	5	Analytical Geometry.....	324
2	Higher Algebra.....	321	2	Theory of Equations.....	323
6	General Chemistry.....	40	6	General Chemistry.....	40
2	Mechanics and Heat.....	430	2	Mechanics and Heat.....	430
3	Free-hand Drawing.....	22	3	Free-hand Drawing.....	22
5	Mechanical Drawing.....	23	5	Mechanical Drawing.....	23
6	Carpentry.....	378	6	Carpentry and Foundry- work.....	378

SOPHOMORE YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	English Literary Epochs.	176	2	English Literary Epochs.	176
2	Recent European History	272	2	American Politics.....	276
3	Differential Calculus.....	325	3	Descriptive Geometry....	327
5	Qualitative Analysis.....	42	3	Integral Calculus.....	326
3	Electricity and Magnet- ism.....	431	3	Sound and Light.....	432
5	Machine Drawing.....	360	5	Principles of Mechanism.	361
2	Laboratory Physics.....	433	2	Laboratory Physics.....	433
6	Forging.....	379	6	Chipping and Filing.....	380

JUNIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Political Economy	450	1	Technical English.....	162
1	Technical English.....	162	2	Analytical and Applied Mechanics	328
5	Analytical and Applied Mechanics	328	3	Dynamo Electricity	131
2	Metallurgy of Iron and Copper.....	47	1	Dynamo Laboratory.....	132
3	Mechanics of Materials...	82	3	Hydraulics.....	372
3	Testing Materials.....	83	3	Hydraulic Laboratory...	375
2	Thermodynamics	365	2	Flue Gas Analysis.....	50
3	Mechanical Laboratory...	367	2	Boilers and Injectors....	368
3	Engineering Drawing	362	5	Elementary Machine De- sign.....	363
3	Heat and other Motors....	366	3	Heat and other Motors....	366
6	Machine-work	381	6	Tool-making.....	381

SENIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
1	Law of Contracts.....	79	2	Foundations	80
3	Framed Structures.....	84	2	Mill Design and Admin- istration.....	376
2	Heating and Ventilation	371	3	Prime Motors.....	370
1	Chimney Construction and Design	369	3	Power Generation..	377
2	Pumps and Pumping Ma- chinery	373	5	Advanced Machine De- sign.....	364
3	Mechanical Laboratory, Pumps....	367	15	Thesis	387
3	Hydraulic Laboratory....	374			
3	Prime Motors.....	377			
3	Advanced Machine De- sign	364			
5	Thesis	387			

VII.—(a) COMBINED ARTS AND CHEMICAL ENGINEERING COURSE FRESHMAN YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Principles of Rhetoric....	160	1	Debates	167
2	Chaucer and the English Language	175	3	Modern English Prose and Composition	161
2	Higher Algebra	322	2	Theory of Equations.....	323
2	Solid Geometry.....	320	3	Shakespeare.....	177
3	General Chemistry.....	40	3	Mediaeval History.....	260
3	Two Language Courses : a. 19th Century French, ..	200	3	General Chemistry.....	40
3	or Classical French ..	202	2	Two Language Courses : a. 19th Century French, ..	200
2	b. Introductory German ..	220	2	or Classical French ..	202
2	or Modern German ..	222	3	b. Introductory German ..	220
5	Prose	222	3	or Modern German ..	222
	Mechanical Drawing.....	23	3	Prose	222
			3	Object Drawing.....	24

SOPHOMORE YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	English Literary Epochs.	176	2	English Literary Epochs.	176
3	Literature from Spenser to Pope.....	178	3	18th Century Literature..	179
3	History of Modern Europe	261	3	One History Course : a. History of Renais- sance.....	263
3	Trigonometry	321	3	b. History of France... ..	264
3	Mechanics and Heat.....	430	3	c. History of England..	265
3	Electricity and Magnet- ism.....	431	5	Analytical Geometry.....	324
2	Laboratory Physics.....	433	2	Mechanics and Heat.....	430
3	Two Language Courses : a. Classical French, <i>or</i>	202	3	Sound and Light	432
2	Outlines of French Literature	203	2	Laboratory Physics.....	433
2	b. Modern German Prose, <i>or</i>	222	2	Two Language Courses : a. Classical French, <i>or</i>	202
3	Outlines of German Literature.....	223	3	Outlines of French Literature	203
5	Machine Drawing.....	360	3	b. Modern German Prose, <i>or</i>	222
			2	Outlines of German Literature.....	223
			2	Advanced Inorganic Chemistry (<i>Optional</i>)....	56

JUNIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
3	19th Century Literature..	180	3	Psychology	411
2	American Political His- tory	268	2	Logic	410
2	Political Economy	450	2	Descriptive Geometry....	327
12	Qualitative Analysis.....	42	5	Principles of Mechanism.	361
	One Language Course:			One Language Course:	
2	a. Mediaeval French <i>or</i> ..	204	2	a. Mediaeval French <i>or</i> ..	204
2	Outlines of French Literature	203	3	Outlines of French Literature	203
2	b. Early German <i>or</i>	224	2	b. Early German <i>or</i>	224
3	Outlines of German Literature	223	2	Outlines of German Literature	223
3	c. Elementary Spanish.	470	3	c. Elementary Spanish.	470

ELECTIVE STUDIES

4 HOURS TO BE SELECTED

4 HOURS TO BE SELECTED

2	Science of Language.....	190	3	English Romantic Move- ment.....	182
2	Old English.....	186	3	Literary Criticism	192
3	American Literature.....	184	3	Tennyson and Browning.	183
1	Argumentative Composi- tion	163	3	Oratory.....	166
2	English Novel.	181	3	History of Renaissance..	263
2	History of Art.....	20	3	History of France.....	264
3	Descriptive Astronomy ..	77	3	History of England.....	265
2	Zoölogy	400	2	History of Art... ..	20
2	General Botany	402	3	Practical Astronomy.....	78
2	History of Education....	100	2	Geology	401
2	Principles of Education..	101	3	Industrial or Economic Botany	403
1	Educational Masterpieces	103	3	Finance.....	451
2	Outlines of French Lit- erature.....	203	3	Sociology.....	452
2	Mediaeval French	204	3	Architecture.....	21
3	Outlines of German Lit- erature	223	3	Outlines of French Lit- erature.....	203
2	Early German.....	224	2	Mediaeval French.....	204
3	Elementary Spanish.....	470	2	Outlines of German Lit- erature... ..	223
2	Educational Psychology..	412	1	Educational Masterpieces	103
1	General Methods of Teaching	105	1	General Methods of Teaching.....	105
3	Spanish Literature.....	471	2	Early German.....	224
3	Elementary Italian	290	3	Elementary Spanish.....	470
5	Mechanical Drawing.....	22	3	Spanish Literature.....	471
3	Alternating Currents....	133	3	Integral Calculus	326
			3	Chipping and Filing	380
			3	Dynamo Electricity.....	131

SENIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
3	History of Ancient and Mediaeval Philosophy..	415	3	Ethics	413
3	Differential Calculus	325	5	Integral Calculus	326
				Thesis for degree of Bachelor of Arts, see page 44.	
ELECTIVE STUDIES					
10 HOURS TO BE SELECTED			10 HOURS TO BE SELECTED		
3	Comparative Study of Literary Types.....	191	3	Comparative Study of Literary Types.....	191
1	Literary Forms.....	164	3	Literary Criticism	192
2	Science of Language... ..	190	3	English Romantic Movement.....	182
2	Old English.....	186	3	Tennyson and Browning.....	183
3	American Literature.....	184	1	Advanced Oratory.....	168
3	English Novel... ..	181	3	History of Renaissance... ..	263
1	Argumentative Composition	163	3	History of France.....	264
2	History of Art.....	20	3	History of England.....	265
2	Educational Psychology..	412	2	Educational Masterpieces	103
2	History of Education.....	100	2	Educational Administration	104
2	Principles of Education..	101	1	General Methods of Teaching.....	105
1	General Methods of Teaching.....	105	3	Modern Philosophy.....	416
3	Descriptive Astronomy ..	77	3	Practical Astronomy	78
2	Zoölogy.....	400	2	Geology	401
3	Special Topics in United States History.....	269	2	History of Art.....	20
2	Aesthetics	414	3	Architecture	21
1	Advanced Oratory.....	168	3	Finance.....	451
2	Advanced Free-hand Drawing	25	3	Sociology.....	452
3	Comparative Constitutional Law	453	2	Advanced Free-hand Drawing.....	25
2	Outlines of French Literature	203	3	International Law.....	454
2	Mediaeval French.....	204	3	Outlines of French Literature	203
3	Outlines of German Literature	223	2	Mediaeval French.....	204
2	Early German.....	224	2	Outlines of German Literature	223
3	Elementary Spanish.....	470	2	Early German.....	224
3	Spanish Literature.....	471	3	Elementary Spanish.....	470
3	Elementary Italian	290	3	Spanish Literature.....	471
5	Mechanical Drawing.....	23	3	Elementary Italian	290
1	Philosophy of Education..	102	3	Integral Calculus	326
1	School Organization and Administration.....	104	1	Philosophy of Education..	102
2	Quantitative Analysis....	44	1	School Organization and Administration.....	104
2	Curriculum and Methods of Elementary School Teaching	106	1	Telephone, Telegraphy and Patent Practice,....	135
			2	Electric Lighting.....	139
			1	Central Station Practice..	141
			2	Special Methods of Teaching.....	107

FIFTH YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
5	Metallurgy	47	3	Machine Design.....	363
2	Industrial Chemistry.....	46	2	Industrial Chemistry.....	46
3	Hydraulics	375	3	Dynamo Electricity.....	131
2	Thermodynamics	365	1	Dynamo Laboratory.....	132
3	Mechanics of Materials...	82	2	Fuel and Gas Analysis...	50
20	Quantitative Analysis....	44	16	Quantitative Analysis....	44
			6	Assaying of Gold and Silver Ores (<i>Optional</i>).....	57

SIXTH YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Physical Chemistry.....	48	6	Water Analysis	53
3	Hydraulic Laboratory....	375	12	Organic Chemistry.....	49
12	Organic Chemistry.....	49	15	Thesis for Degree of Chemical Engineer.....	64
15	Thesis	64	2	Thermo-Chemistry	52
6	Electrolysis and Electro- Synthesis of Organic Compounds	58	6	Chemistry of Fabrics (<i>Optional</i>).....	55

VII.—(b) COMBINED ARTS AND CIVIL ENGINEERING COURSE

FRESHMAN YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Principles of Rhetoric....	160	1	Debates	167
2	Chaucer and the English Language.....	175	3	Modern English Prose and Composition.....	161
2	Higher Algebra.....	322	2	Theory of Equations.....	323
2	Solid Geometry.....	320	3	Shakespeare	177
3	General Chemistry.....	40	3	Mediaeval History.....	260
3	Two Language Courses: a. 19th Century French..	200	3	General Chemistry.....	40
3	or Classical French..	202	2	Two Language Courses: a. 19th Century French..	200
2	b. Introductory Ger- man or.....	220	2	or Classical French..	202
2	Modern German Prose	222	3	b. Introductory Ger- man or.....	220
5	Mechanical Drawing.....	23	3	Modern German Prose	222

SOPHOMORE YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	English Literary Epochs.	176	2	English Literary Epochs.	176
3	Literature from Spenser to Pope.....	178	3	18th Century Literature..	179
3	History of Modern Europe	261	3	One History Course: a. History of Renais- sance	263
3	Trigonometry	322	3	b. History of France...	264
2	Mechanics and Heat.....	430	3	c. History of England..	265
3	Electricity and Magnet- ism.....	431	5	Analytical Geometry....	324
2	Laboratory Physics.....	433	2	Mechanics and Heat.....	430
3	Two Language Courses: a. Classical French or..	202	3	Sound and Light.....	432
2	Outlines of French Literature.....	203	2	Laboratory Physics.....	433
2	b. Modern German Prose or.....	222	2	Two Language Courses: a. Classical French or..	202
3	Outlines of German Literature.....	223	3	Outlines of French Literature.....	203
2	Zoölogy	400	2	b. Modern German Prose.....	222
5	Machine Drawing.....	360	2	Outlines of German Literature.....	223
			2	Geology	401

JUNIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
3	19th Century Literature..	180	3	Psychology	411
2	American Political His- tory.....	268	2	Logic.....	410
2	Political Economy	450	3	Descriptive Geometry....	327
5	Qualitative Analysis	42	5	Principles of Mechanism..	361
	One Language Course:			One Language Course:	
2	a. Mediaeval French <i>or</i>	204	2	a. Mediaeval French, <i>or</i>	204
2	Outlines of French Literature	205	3	Outlines of French Literature	203
2	b. Early German <i>or</i>	224	2	b. Early German <i>or</i>	224
3	Outlines of German Literature.....	223	2	Outlines of German Literature.....	223
2	c. Elementary Spanish..	470	3	c. Elementary Spanish..	470
6	Carpentry.....	378	6	Carpentry and Foundry..	378

ELECTIVE STUDIES

4 HOURS TO BE SELECTED			4 HOURS TO BE SELECTED		
2	Science of Language.....	190	3	English Romantic Move- ment.....	182
2	Old English.....	186	3	Literary Criticism	192
3	American Literature	184	3	Tennyson and Browning..	183
1	Argumentative Composi- tion	163	1	Oratory.....	166
3	English Novel.....	131	3	History of Renaissance ..	263
2	History of Art.....	20	3	History of France.....	264
3	Descriptive Astronomy..	77	3	History of England.....	265
2	General Botany	402	2	History of Art.....	20
2	History of Education....	100	3	Practical Astronomy	78
2	Principles of Education ..	101	3	Industrial or Economic Botany	403
1	Educational Masterpieces	103	3	Finance.....	451
2	Outlines of French Liter- ature.....	203	3	Sociology	452
2	Mediaeval French.....	204	3	Architecture.....	21
3	Outlines of German Lit- erature	223	3	Outlines of French Liter- ature.....	203
2	Early German.....	224	2	Mediaeval French.....	204
3	Elementary Spanish.....	470	2	Outlines of German Lit- erature.....	223
2	Educational Psychology..	412	1	Educational Masterpieces	103
1	General Methods of Teaching.....	105	1	General Methods of Teaching.....	105
3	Spanish Literature.....	471	2	Early German	224
3	Elementary Italian.....	290	3	Elementary Spanish.....	470
5	Mechanical Drawing.....	23	3	Spanish Literature.....	471
3	Alternating Currents.....	133	3	Integral Calculus	326
			3	Chipping and Filing.....	380
			3	Dynamo Electricity.....	131

SENIOR YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
3	History of Ancient and Mediaeval Philosophy..	415	3	Ethics	413
3	Differential Calculus	325	3	Integral Calculus	329
3	Forge Work.....	379	3	Chipping and Filing.....	385
3	Elementary Surveying...	70	9	General Field Work... ..	72
3	Leveling.....	71		Thesis for degree of Bachelor of Arts, see page 44.	

ELECTIVE STUDIES

10 HOURS TO BE SELECTED

10 HOURS TO BE SELECTED

3	Comparative Study of Literary Types.....	191	3	Comparative Study of Literary Types.....	191
1	Literary Forms.....	164	3	Literary Criticism.....	192
2	Science of Language.....	190	3	English Romantic Movement.....	182
2	Old English.....	186	3	Tennyson and Browning..	183
3	American Literature	184	1	Advanced Oratory.....	168
3	English Novel.....	181	3	History of Renaissance...	263
1	Argumentative Composition	163	3	History of France.....	264
2	History of Art.....	20	3	History of England.....	265
2	Educational Psychology..	412	2	Educational Masterpieces	103
2	History of Education.....	100	2	Educational Administration	104
2	Principles of Education..	101	1	General Methods of Teaching.....	105
1	General Methods of Teaching.....	105	3	Modern Philosophy.....	416
3	Descriptive Astronomy ..	77	3	Practical Astronomy.....	78
2	Zoölogy	400	2	Geology.....	401
2	General Botany	402	3	Industrial and Economic Botany	403
3	Special Topics in United States History.....	269	2	History of Art.....	20
2	Aesthetics.....	414	3	Architecture.....	21
1	Advanced Oratory.. ..	168	3	Finance	451
2	Advanced Free-hand Drawing.....	25	3	Sociology	452
3	Comparative Constitutional Law	453	2	Advanced Free-hand Drawing.....	25
2	Outlines of French Literature.....	203	3	International Law	454
2	Mediaeval French.....	204	3	Outlines of French Literature.....	203
3	Outlines of German Literature	223	2	Mediaeval French.....	204
2	Early German.....	224	2	Outlines of German Literature	223
3	Elementary Spanish.....	470	2	Early German.....	224
3	Spanish Literature.....	471	3	Elementary Spanish.....	470
3	Elementary Italian	290	3	Spanish Literature.....	471
5	Mechanical Drawing.....	23	3	Elementary Italian	290
1	Philosophy of Education..	102	3	Integral Calculus	326
1	School Organization and Administration.....	104	3	Philosophy of Education..	102
2	Quantitative Analysis.....	42	1	School Organization and Administration.....	104
2	Curriculum and Methods of Elementary School Teaching.....	106	1	Telephone, Telegraphy and Patent Practice....	135
			2	Electric Lighting.....	139
			1	Central Station Practice..	141
			2	Special Methods of Teaching.....	107

FIFTH YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
5	Analytical and Applied Mechanics	328	2	Analytical and Applied Mechanics.....	328
2	Topographical Drawing..	74	3	Architecture.....	21
3	Mechanics of Materials...	82	3	Mechanics of Materials...	82
3	Testing Materials.....	83	3	Heat and other Motors...	366
3	Mechanical Laboratory...	367	3	Hydromechanics	372
2	Thermodynamics	365	3	Hydraulic Laboratory...	374
3	Heat and other Motors....	366	5	Hydrographic Triangu- lation and Stadia Sur- vey	75
3	Railway Survey.....	76	3	Spherical and Practical Astronomy	78
3	General Astronomy.....	77	3	Tool-making.....	381

SIXTH YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Differential Equations....	329	2	Probability and Least Squares.....	330
1	Law of Contracts.....	79	2	Foundations	80
3	Framed Structures.....	84	3	Arches and Dams.....	81
2	Street and Road Engi- neering.....	85	4	Framed Structures.....	84
2	Water Supply and Irriga- tion.....	86	2	Design and Specifications Thesis for Degree of Civil Engineer	88
3	Drainage Survey.....	87	15		93
2	Design und Specifications	88			
10	Thesis.....	93			

VII.—(c) COMBINED ARTS AND ELECTRICAL ENGINEERING COURSE

FRESHMAN YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Principles of Rhetoric....	160	1	Debates	167
2	Chaucer and the English Language	175	3	Modern English Prose and Composition	161
2	Higher Algebra	322	2	Theory of Equations....	323
2	Solid Geometry	320	3	Shakespeare	177
3	General Chemistry	40	3	Mediaeval History	260
	Two Language Courses :		3	General Chemistry	40
3	a. 19th Century French,	200	2	Two Language Courses :	
3	or Classical French..	202	2	a. 19th Century French	200
2	b. Introductory German	220	2	or Classical French..	202
2	or Modern German		3	b. Introductory German	220
	Prose	222	3	or Modern German	
5	Mechanical Drawing.....	23		Prose	222

SOPHOMORE YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	English Literary Epochs.	176	2	English Literary Epochs.	176
3	Literature from Spenser to Pope.....	178	3	18th Century Literature..	179
3	History of Modern Europe	261	3	One History Course	
3	Trigonometry	322	a. History of Renais-		
2	Mechanics and Heat.....	430	sance.....		263
3	Electricity and Magnet-		b. History of France ...		264
	ism.....	431	c. History of England..		265
2	Laboratory Physics.....	433	Analytical Geometry....		324
	Two Language Courses		Mechanics and Heat.....		430
3	a. Classical French, or	202	Sound and Light.....		432
2	Outlines of French		Laboratory Physics.....		433
	Literature.....	203	Two Language Courses		
2	b. Modern German		a. Classical French, or		202
	Prose, or.....	222	Outlines of French		
3	Outlines of German		Literature		203
	Literature.....	223	b. Modern German		
5	Machine Drawing.....	360	Prose, or.....		222
			Outlines of German		
			Literature.....		223

JUNIOR YEAR

Hours a week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
3	19th Century Literature ..	180	3	Psychology	411
2	American Political His- tory	268	2	Logic	410
2	Political Economy	450	3	Descriptive Geometry....	327
5	Qualitative Analysis	42	5	Principles of Mechanism.	361
2	One Language Course :		2	One Language Course :	
2	a. Mediaeval French <i>or</i>	204	2	a. Mediaeval French <i>or</i>	204
2	Outlines of French Literature	203	3	Outlines of French Literature	203
2	b. Early German, <i>or</i>	224	2	b. Early German, <i>or</i>	224
3	Outlines of German Literature	223	2	Outlines of German Literature	223
3	c. Elementary Spanish.	470	3	c. Elementary Spanish.	470
6	Carpentry	378	6	Carpentry and Foundry	378

ELECTIVE STUDIES

4 HOURS TO BE SELECTED

4 HOURS TO BE SELECTED

2	Science of Language.....	190	3	English Romantic Move- ment	182
2	Old English	186	3	Literary Criticism	192
3	American Literature	184	3	Tennyson and Browning.	183
1	Argumentative Composi- tion	163	1	Oratory	166
3	English Novel	181	3	History of Renaissance.	263
2	History of Art	20	3	History of France	264
3	Descriptive Astronomy..	77	3	History of England.....	265
2	History of Education....	100	2	History of Art	20
2	Principles of Education..	101	3	Practical Astronomy....	78
1	Educational Masterpieces	103	3	Finance	451
2	Zoölogy	400	3	Sociology	452
2	General Botany	402	3	Architecture	21
2	Outlines of French Litera- ture	203	2	Geology	401
2	Mediaeval French	204	3	Industrial or Economic Botany	403
3	Outlines of German Lit- erature	223	3	Outlines of French Liter- ature	203
2	Early German	224	2	Mediaeval French	204
3	Elementary Spanish	470	2	Outlines of German Lit- erature	223
2	Educational Psychology.	412	1	Educational Masterpieces	103
1	General Methods of Teaching	105	1	General Methods of Teaching	105
3	Spanish Literature	471	2	Early German	224
3	Elementary Italian	290	3	Elementary Spanish	470
5	Mechanical Drawing	23	3	Spanish Literature	471
3	Alternating Currents....	133	3	Integral Calculus	326
			3	Chipping and Filing	380
			3	Dynamo Electricity	131

SENIOR YEAR

PRESCRIBED STUDIES

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
3	History of Ancient and Mediaeval Philosophy..	415	3	Ethics	413
3	Differential Calculus	325	3	Integral Calculus	326
3	Forge Work.....	379	3	Chipping and Filing	380
				Thesis for degree of Bachelor of Arts, see page 44	

ELECTIVE STUDIES

10 HOURS TO BE SELECTED

10 HOURS TO BE SELECTED

3	Comparative Study of Literary Types.....	191	3	Comparative Study of Literary Types.....	191
1	Literary Forms.....	164	3	Literary Criticism	192
2	Science of Language.....	190	3	English Romantic Movement.....	182
2	Old English.....	186	3	Tennyson and Browning.	183
3	American Literature.....	184	1	Advanced Oratory	168
3	English Novel.....	181	3	History of Renaissance...	263
1	Argumentative Composition.....	163	3	History of France.....	264
2	History of Art.....	20	3	History of England	265
2	Educational Psychology..	412	1	Educational Masterpieces	103
2	History of Education.....	100	2	Educational Administration	104
2	Principles of Education..	101	1	General Methods of Teaching.....	105
1	General Methods of Teaching.....	105	3	Modern Philosophy.....	416
1	Educational Masterpieces	103	3	Practical Astronomy	78
3	Descriptive Astronomy...	77	2	Geology	401
3	Zoölogy.....	400	3	Industrial or Economic Botany.....	403
2	General Botany.....	402	2	History of Art.....	20
3	Special Topics in United States History.....	269	3	Architecture.....	21
2	Aesthetics	414	3	Finance.....	451
1	Advanced Oratory.....	168	3	Sociology	452
2	Advanced Free-hand Drawing.....	25	2	Advanced Free-hand Drawing	25
3	Comparative Constitutional Law	453	3	International Law	454
2	Outlines of French Literature.....	203	3	Outlines of French Literature.....	203
2	Mediaeval French	204	2	Mediaeval French.....	204
3	Outlines of German Literature.....	223	2	Outlines of German Literature.....	223
2	Early German.....	224	2	Early German.....	224
3	Elementary Spanish.....	470	3	Elementary Spanish.....	470
3	Spanish Literature.	471	3	Spanish Literature	471
3	Elementary Italian.....	290	3	Elementary Italian.....	290
5	Mechanical Drawing.....	23	3	Integral Calculus	326
1	Philosophy of Education.	102	1	Philosophy of Education.	102
1	School Organization and Administration	104	1	School Organization and Administration	104
2	Quantitative Analysis....	45	1	Telephone, Telegraphy, Patent Practice.....	135
2	Curriculum and Methods of Elementary School Teaching	106	2	Electric Lighting.....	139
			1	Central Station Practice..	141
			2	Special Methods of Teaching	107

FIFTH YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
5	Analytical Mechanics.....	328	2	Analytical Mechanics	328
2	Quantitative Analysis....	45	3	Dynamo Electricity.....	131
3	Mechanics of Materials....	82	3	Dynamo Laboratory.....	132
3	Testing Materials.....	83	3	Hydromechanics	372
3	Mechanical Laboratory...	367	3	Hydraulic Laboratory....	375
2	Thermodynamics..	365	5	Elementary Machine De- sign	363
3	Heat and other Motors....	366	3	Heat and other Motors....	366
3	Machine-work	381	3	Tool-making.....	381
1	Materials of Electric Con- struction	130			

SIXTH YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Differential Equations....	329	1	Telephony, Telegraphy and Patent Practice.....	135
1	Law of Contracts.....	79	1	Electric Traction.....	136
3	Framed Structures.....	84	1	Electrical Power Trans- mission	137
3	Power Generation and Distribution	370	2	Electrical Design.....	138
2	Metallurgy of Iron and Copper.....	47	2	Electric Lighting	139
3	Alternating Currents....	133	15	Thesis for degree of Elec- trical Engineer.....	142
9	Alternating Current Lab- oratory	134			
2	Electrical Design	138			
1	Central Station Practice..	141			
1/2	Commercial Electrical Engineering	140			
10	Thesis	142			

VII.—(d) COMBINED ARTS AND MECHANICAL ENGINEERING COURSE

FRESHMAN YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	Principles of Rhetoric....	160	1	Debates	167
2	Chaucer and the English Language	175	3	Modern English Prose and Composition	161
2	Higher Algebra.....	322	2	Theory of Equations.....	323
2	Solid Geometry	320	3	Shakespeare	177
3	General Chemistry	40	3	Mediaeval History.....	260
3	Two Language Courses :		3	General Chemistry	40
3	a. 19th Century French,	200		Two Language Courses :	
3	or Classical French..	202	2	a. 19th Century French	200
2	b. Introductory German	220	2	or Classical French..	202
2	or Modern German		3	b. Introductory German	220
	Prose	222	3	or Modern German	
3	Free-hand Drawing.....	22		Prose	222
			3	Free-hand Drawing.....	22

SOPHOMORE YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
2	English Literary Epochs.	176	2	English Literary Epochs.	176
3	Literature from Spenser to Pope.....	178	3	18th Century Literature..	179
3	History of Modern Europe	261	3	One History Course	
3	Trigonometry	321		a. History of Renais- sance.....	263
2	Mechanics and Heat.....	430	3	b. History of France ...	264
3	Electricity and Magnet- ism.....	431	3	c. History of England..	265
2	Laboratory Physics.....	433	5	Analytical Geometry.....	324
3	Two Language Courses		2	Mechanics and Heat.....	430
3	a. Classical French, or	202	3	Sound and Light.....	432
2	Outlines of French Literature.....	203	2	Laboratory Physics.....	433
2	b. Modern German		2	Two Language Courses	
	Prose, or.....	222	3	a. Classical French, or	202
3	Outlines of German Literature.....	223	3	Outlines of French Literature	203
5	Machine Drawing.....	360	2	b. Modern German	
				Prose, or.....	222
				Outlines of German Literature.....	223

JUNIOR YEAR

Hours a week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
3	19th Century Literature..	180	3	Psychology	411
2	American Political His- tory.....	268	2	Logic.....	410
2	Political Economy	450	3	Descriptive Geometry....	327
5	Qualitative Analysis.....	42	5	Principles of Mechanism.	361
2	One Language Course:		2	One Language Course:	
2	a. Mediaeval French <i>or</i>	204	3	a. Mediaeval French <i>or</i>	204
2	Outlines of French			Outlines of French	
	Literature.....	203		Literature	203
2	b. Early German, <i>or</i>	224	2	b. Early German, <i>or</i>	224
3	Outlines of German	223	2	Outlines of German	
	Literature.....			Literature	223
3	c. Elementary Spanish.	470	3	c. Elementary Spanish.	470
6	Carpentry	378	6	Carpentry and Foundry	378

ELECTIVE STUDIES

4 HOURS TO BE SELECTED

4 HOURS TO BE SELECTED

2	Science of Language.....	190	3	English Romantic Move- ment	182
2	Old English.....	186	3	Literary Criticism	192
3	American Literature.....	184	3	Tennyson and Browning.	183
1	Argumentative Composi- tion	163	3	Oratory	166
3	English Novel.....	181	1	History of Renaissance..	263
2	History of Art	20	3	History of France	264
3	Descriptive Astronomy..	77	3	History of England.....	265
2	History of Education....	100	2	History of Art	20
2	Principles of Education..	101	3	Practical Astronomy....	78
1	Educational Masterpieces	103	3	Finance	451
2	Zoölogy.....	400	3	Sociology	452
2	General Botany.....	402	3	Architecture.....	21
2	Outlines of French Litera- ture	203	2	Geology.....	401
2	Mediaeval French.....	204	3	Industrial or Economic Botany.....	403
3	Outlines of German Lit- erature	223	3	Outlines of French Liter- ature	203
2	Early German.....	224	2	Mediaeval French.....	204
3	Elementary Spanish.....	470	2	Outlines of German Lit- erature.....	223
2	Educational Psychology.	412	1	Educational Masterpieces	103
1	General Methods of Teaching	105	1	General Methods of Teaching	105
3	Spanish Literature.....	471	2	Early German.....	224
3	Elementary Italian.....	290	3	Elementary Spanish.....	470
5	Mechanical Drawing	23	3	Spanish Literature	471
3	Alternating Currents....	133	3	Integral Calculus.....	326
			3	Chipping and Filing.....	380
			3	Dynamo Electricity	131

SENIOR YEAR PRESCRIBED STUDIES

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
3	History of Ancient and Mediaeval Philosophy..	415	3	Ethics	413
3	Differential Calculus	325	3	Integral Calculus	326
6	Forge Work.....	379	6	Chipping and Filing	380
				Thesis for degree of Bachelor of Arts, see page 44.	

ELECTIVE STUDIES

10 HOURS TO BE SELECTED

10 HOURS TO BE SELECTED

3	Comparative Study of Literary Types.....	191	3	Comparative Study of Literary Types.....	191
1	Literary Forms.....	164	3	Literary Criticism	192
2	Science of Language.....	190	3	English Romantic Movement.....	182
2	Old English.....	186	3	Tennyson and Browning.....	183
3	American Literature.....	184	1	Advanced Oratory	168
3	English Novel.....	181	3	History of Renaissance... ..	263
1	Argumentative Composition.....	163	3	History of France.....	264
2	History of Art.....	20	3	History of England	265
2	Educational Psychology..	412	1	Educational Masterpieces	103
2	History of Education....	100	2	Educational Administration	104
1	Educational Masterpieces	103	1	General Methods of Teaching.....	105
2	Principles of Education..	101	3	Modern Philosophy.....	416
1	General Methods of Teaching.....	105	3	Practical Astronomy	78
3	Descriptive Astronomy... ..	77	2	Geology	401
2	Zoölogy.....	400	3	Industrial or Economic Botany.....	403
2	General Botany.....	402	2	History of Art.....	20
3	Special Topics in United States History.....	269	3	Architecture.....	21
2	Aesthetics	414	3	Finance.....	451
1	Advanced Oratory.....	168	3	Sociology.. ..	452
2	Advanced Free-hand Drawing.....	25	2	Advanced Free-hand Drawing	25
3	Comparative Constitutional Law	453	3	International Law	454
2	Outlines of French Literature.....	203	3	Outlines of French Literature.....	203
2	Mediaeval French	204	2	Mediaeval French.....	204
3	Outlines of German Literature.....	223	2	Outlines of German Literature.....	223
2	Early German.....	224	2	Early German.....	224
3	Elementary Spanish.....	470	3	Elementary Spanish.....	470
3	Spanish Literature	471	3	Spanish Literature	471
3	Elementary Italian.....	290	3	Elementary Italian.....	290
1	Mechanical Drawing.....	23	3	Integral Calculus	326
5	Philosophy of Education..	102	1	Philosophy of Education..	102
1	School Organization and Administration.....	104	1	School Organization and Administration.....	104
2	Quantitative Analysis....	45	1	Telephone, Telegraphy, Patent Practice.....	135
2	Curriculum and Methods of Elementary School Teaching.....	106	2	Electric Lighting.....	139
			1	Central Station Practice..	141
			2	Special Methods of Teaching	107

FIFTH YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
5	Analytical and Applied Mechanics.....	328	2	Analytical and Applied Mechanics	328
2	Metallurgy of Iron and Copper.....	47	3	Dynamo Electricity.....	131
3	Mechanics of Materials..	82	1	Dynamo Laboratory.....	132
3	Testing Materials.....	83	3	Hydromechanics	372
2	Thermodynamics.....	365	3	Hydraulic Laboratory...	375
3	Mechanical Laboratory...	367	2	Fuel and Gas Analysis...	50
3	Engineering Drawing	362	2	Boilers and Injectors	368
3	Heat and other Motors....	366	5	Elementary Machine Design	363
3	Machine-work.....	381	3	Heat and other Motors ...	366
			6	Tool-making.....	379

SIXTH YEAR

Hours a Week	First Semester	Course Number	Hours a Week	Second Semester	Course Number
1	Law of Contracts.....	79	2	Foundations	80
3	Framed Structures.....	84	2	Mill Design and Administration.....	376
2	Heating and Ventilating of Buildings.....	371	3	Prime Motors.....	377
1	Chimney Construction and Design.....	369	5	Advanced Machine Design.....	364
2	Pumps and Pumping Machinery.....	373	3	Power Generation.....	370
3	Mechanical Laboratory, Pumps.....	367	15	Thesis for degree of Mechanical Engineer...	387
3	Hydraulic Laboratory ...	375			
3	Prime Motors.....	377			
3	Advanced Machine Design	364			
5	Thesis for degree of Mechanical Engineer...	387			

VIII.—(a) GENERAL COURSE IN PEDAGOGY

A broad course in Education to be taken (1) independently, or (2) in connection with the requirements of the Course in Arts leading to the degree of Bachelor of Arts, or (3) by candidates for the degree of Master of Arts who present education as a major, or a major and one minor subject. In the latter case the student's choice must be made from the more advanced and distinctly professional subjects.

SUBJECT	Total Hours	Course Number	Described at Page
Logic	30	410	196
Psychology	45	411	196
Educational Psychology.....	30	412	196
Ancient and Mediaeval Philosophy.	45	415	197
Modern Philosophy	45	416	197
Ethics.....	45	413	196
Sociology	45	452	201
History of Education.....	30	100	143
Principles of Education	30	101	144
Philosophy of Education.....	30	102	144
Educational Masterpieces.....	30	103	144
School Organization and Administration.....	30	104	145
General Methods.....	30	105	145
Curriculum and Methods of Elementary School Teaching.....	30	106	146
Special Methods.....	30	107	146

VIII.—(b) LICENSE COURSE IN PEDAGOGY

This is the Minimum requirement in Pedagogy accepted as the basis of examination for State and City licenses for teachers.

SUBJECT	Total Hours	Course Number	Described at Page
Logic	30	410	196
Psychology	45	411	196
History of Education.....	30	100	143
Principles of Education	30	101	144
Philosophy of Education	30	102	144
General Methods.....	30	105	145
Curriculum and Methods of Elementary School Teaching.....	30	106	146
Special Methods.....	30	107	146

IX. and X.—SCHEDULE OF GRADUATE STUDIES

IX.—Graduate Students in Arts must select from the following table at least 120 lecture hours for a major subject, and at least 60 hours for each of two minor subjects; the major subject to lie in one of the following departments: Education, English and Comparative Literature, French, German, History, Greek, Latin, Mathematics, Philosophy, and Political and Social Science. For the second minor, certain undergraduate studies in science may be substituted upon obtaining consent of the Registrar.

X.—Graduate Students in Science must select from the following table at least 180 lecture hours for a major subject, and at least 90 hours for each of two minor subjects; the major subject to lie in one of the following departments: Mathematics, Chemistry, and Chemical Engineering; Civil, Electrical, and Mechanical Engineering. For the second minor, certain undergraduate studies of the Arts Course may be substituted upon obtaining consent of the Registrar.

In the table on the following pages, subjects that are starred are open to qualified undergraduates as well as to graduate students. Subjects unstarred are open only to graduate students.

GRADUATE STUDIES.

	SUBJECT	Total Hours	Course Number	De- scribed at Page
	CHEMISTRY			
*	Sanitary and Industrial Water Supply ..	12	60	131
*	Shellac, Varnishes and Glycerine	6	61	131
*	Foods and their Adulteration.....	12	62	131
*	General Technical Chemistry.....	10	63	132
	Advanced Organic Chemistry.....	300	65	132
	Advanced Industrial Chemistry.....	300	66	132
	Advanced Inorganic Chemistry	300	67	132
	CIVIL ENGINEERING			
*	Municipal Engineering	8	89	139
*	Tunnels and Foundations	4	90	139
*	Roofs and Bridges.....	8	91	139
*	Electric Street Railways.....	4	92	139
	Bridge Designing.....	90	94	140
	Sanitary Engineering.....	60	95	140
	EDUCATION			
*	Principles of Education.....	30	101	142
*	Philosophy of Education.....	30	102	142
*	Educational Masterpieces.	30	103	142
*	School Organization and Administration	30	104	143
*	General Methods of Teaching.....	30	105	143
*	Special Methods of Teaching.....	30	107	144
*	Curriculum and Methods of Elementary School Teaching.....	30	106	143
	ELECTRICAL ENGINEERING			
*	Telephony, Telegraphy and Patent Prac- tice.....	15	135	146
*	Electrical Power Transmission.....	15	137	147
*	Electric Traction.....	15	136	146
*	Central Station Practice.....	15	141	148
*	Commercial Electrical Engineering.....	8	140	147
	Electrical Research Laboratory.....	150	143	148
	Advanced Electrical Engineering De- sign	75	144	149

GRADUATE STUDIES

	SUBJECT	Total Hours	Course Number	De- scribed at Page
	ENGLISH AND COMPARATIVE LITERATURE			
*	English Novel.....	43	181	153
*	English Romantic Movement.....	45	182	153
*	Tennyson and Browning.....	45	183	154
*	American Literature.....	45	184	154
*	Middle English.....	45	185	154
*	Old English.....	30	186	155
*	Literary Criticism.....	45	192	156
	English Essay.....	60	187	155
	Comparative Study of Literary Types...	90	191	155
*	The Comic.....	60	193	156
	Literary Relations between England and Germany.....	60	194	157
	Old Testament Themes in Modern Lit- erature.....	60	195	157
	FRENCH			
	The French Novel.....	60	206	160
	The French Theatre.....	60	207	160
	French Prose of the 17th and 18th Cen- turies	60	208	160
	GERMAN			
	Mediaeval German Epic and Lyric.....	90	226	163
	Old High German.....	60	227	163
	Gothic.....	60	228	163
	Luther.....	60	229	164
	Lessing.....	90	230	164
	Herder.....	90	231	164
	GREEK			
	Greek Lyric Poetry	60	245	166
	Poetics of Aristotle.....	60	246	166
	HISTORY			
	Political History of the United States (1783-1829).....	60	270	170
	Studies in National Government	60	271	170
	History of Spain.....	60	272	170
	Modern Germany.....	60	273	171
	Greek and Roman History	60	274	171
	History of Mohammedan Conquest.....	60	275	171
	ITALIAN			
*	Dante.....	60	291	172

GRADUATE STUDIES

	SUBJECT	Total Hours	Course Number	De- scribed at Page
	LATIN			
	Roman Satire	60	305	174
	Catullus and the Elegiac Poets.....	60	306	174
	MATHEMATICS			
*	Advanced Descriptive Geometry.....	30	331	179
*	Advanced Calculus.....	30	332	179
*	Advanced Differential Equations.....	50	333	179
*	Fourier's Series and Harmonic Func- tions.....	30	334	179
*	Calculus of Finite Differences.....	30	335	180
*	Vector Analysis and Quaternions.....	30	336	180
	Theory of Functions	30	337	180
	Theory of Invariants.....	30	338	180
	MECHANICAL ENGINEERING			
*	Mechanical Equipment of Tall Buildings	12	382	188
*	Heating and Ventilating.....	16	383	188
*	Aerodynamics	4	384	189
*	Refrigeration and Cold Storage	12	385	189
*	Commercial Fuels.....	4	386	189
	Locomotive Engineering and Design.....	150	388	190
	Propelling Machinery.....	150	339	190
	PHILOSOPHY			
*	Aesthetics	30	414	194
	Readings in the Literature of Ethics.....	60	419	195
	British Philosophy.....	60	418	195
	Studies in Contemporary Philosophy....	60	421	195
	Kant and His Successors	60	420	195
	Philosophical Types.....	60	417	195
	PHYSICS			
	Physical Theory.....	45	435	197
	POLITICAL AND SOCIAL SCIENCE			
	Economic Theory.....	60	455	199
	Industrial Development	60	456	199
	SPANISH			
	Old Spanish	60	472	200
	The Cid	60	473	200
	Spanish Drama	60	474	200
	The Novela.....	60	475	201

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Departments and Subjects of Instruction

I. ART

PROFESSOR HERZBERG AND MR. ADAMS.

A. THEORETICAL.

20. HISTORY OF ART. A review of the history of sculpture and painting from ancient and classic times to the present. *Elective* for Juniors and Seniors in Arts; two hours,* both semesters.

21. ARCHITECTURE. A survey of the development of the so-called historical styles, and an examination of the principal structures in all countries best representing those styles, followed by a study of the proportions adopted by the Renaissance, and a reproduction of the details of the classical forms employed in the Modern Renaissance. *Elective* for Juniors and Seniors in Arts; three hours, second semester.

B. PRACTICAL.

22. FREE-HAND DRAWING. A course involving the use of pencil, charcoal, crayon, pen, and brush, with outline work from the flat, lettering, and the drawing of blocks, ornaments, and casts

* "Hours" indicates the average number of hours a week in all cases where the semesters are specified. In other cases "Hours" indicates the total number of hours in the course.

from the real object. Freshmen in Civil and Mechanical Engineering, and *optional* for Freshmen in Arts; three hours, both semesters.

23. MECHANICAL DRAWING. A course in mechanical drawing, and orthographic projection embodying problems of points, lines, planes, surfaces and solids. The second semester is devoted to isometric drawing, shades, shadows, developments of surfaces, and elementary machine drawing, including bolts, screws, rivets, springs, etc. Freshmen in Engineering and Chemistry, five hours, first semester. Freshmen in Civil, Electrical, and Mechanical Engineering; five hours, both semesters. Freshmen in Chemistry and Chemical Engineering, five hours, first semester.

25. ADVANCED FREE-HAND DRAWING. *Optional* for Juniors and Seniors in Arts; two hours, both semesters.

26. FREE-HAND DRAWING. In this course the student is trained in object sketching, lettering, the making of working sketches, and the construction of titles. Special attention is paid to the proper arrangement on the sheet of sketches and titles, and one of the principal objects of the course is to develop the power of depicting objects in their correct proportions. Freshmen in Civil Engineering; two hours, first semester; one hour, second semester.

II. CHEMISTRY AND CHEMICAL ENGINEERING

PROFESSOR FAY, PROFESSOR OLSEN, PROFESSOR WHIPPLE,
MR. OAKLEAF, AND MR. HAWKINS.

40. GENERAL CHEMISTRY. A thorough and systematic review of descriptive chemistry given by means of lectures, recitations, and laboratory practice, involving text-book study, stoichiometrical calculations, and the performance of two hundred different experiments. Laboratory instruction is individual, and a record of all laboratory work is kept, examined, and corrected. Freshmen on all courses; three hours, both semesters, of lectures; three hours, both semesters, of laboratory practice. (For students on the Arts Course, the laboratory practice is optional.)

41. QUALITATIVE ANALYSIS. A systematic course in qualitative analysis both basic and acid. The analysis is largely that of ores, slags, alloys, and minerals. The course is chiefly pursued in the laboratory, but it is supplemented by lectures. Sophomores in Chemistry; twelve hours, first semester; eighteen hours, second semester; Sophomores in Chemical Engineering; twelve hours, first semester; fifteen hours, second semester.

42. QUALITATIVE ANALYSIS. This course includes instruction in basic analysis and blow-pipe

analysis. The selection of problems for analysis is made with especial attention to the needs of engineering students. Sophomores in Engineering; five hours, first semester.

43. BLOW-PIPE ANALYSIS. A thorough course in the various methods used in studying reactions before the blow-pipe. Sophomores in Chemistry; six hours, first semester.

44. QUANTITATIVE ANALYSIS. An extended course in quantitative analysis, gravimetric, electrolytic, and volumetric. Especial attention is given to testing the balance, calibration of weights, and volumetric apparatus. Pure salts and simple compounds are first analyzed. Ores, minerals and technical products are then studied. Later in the course, optional courses for specialization are offered in the analysis of iron and steel, coal, water, fuels, oil, and gases. Juniors in Chemistry; twenty hours, first semester; twenty-three hours, second semester; Juniors in Chemical Engineering; twenty hours, first semester; sixteen hours, second semester.

45. QUANTITATIVE ANALYSIS. A course designed for electrical engineers, in which the work consists largely of determinations by means of the electric current. Practice is also had in volumetric analysis, the subjects chosen having a bearing upon the student's electrical work. Jun-

iors in Electric Engineering; two hours, first semester.

46. INDUSTRIAL CHEMISTRY. A study of chemical processes upon a manufacturing scale, and under conditions widely different from those existing in laboratory experimentation. Enough of the history of processes is given to show the advance in chemical industry to the present time; and by-products, the utilization of waste products, and their influence upon successful manufacturing are especially considered. The scope of this course is further extended by the evening lectures upon special phases of the subject by the Consulting Professors of Chemistry, as practising experts in their several fields. The actual conditions of the prosecution of factory work are examined by means of excursions to the great manufactories of New York and neighboring cities. Juniors in Chemistry and Chemical Engineering; two hours, second semester.

47. METALLURGY. A study of the ores of gold, silver, iron, copper, and lead, and of the various methods of their smelting as determined by the geographical distribution of the ores, fuels, and fluxes. The purification of the crude products, and the qualities and the uses of the metals are treated in detail. Juniors in Chemistry and Chemical Engineering; five hours, first semester;

Juniors in Mechanical Engineering and Seniors in Electrical Engineering, for the metallurgy of iron and copper especially; two hours, first semester.

48. THEORETICAL AND PHYSICAL CHEMISTRY. A study of the development of chemical theory and of its influence upon industrial progress. Especial attention is given to molecular weight determination and to the theory of electrolytic dissociation. Seniors in Chemistry; two hours, first semester.

49. ORGANIC CHEMISTRY. A detailed study of organic chemistry with especial reference to its theory, involving a large amount of practical work in the preparation and purification of typical organic compounds, together with considerable practice in ultimate analysis. Seniors in Chemistry; three hours of lectures, both semesters; twelve hours of laboratory, first semester; eighteen hours, second semester.

50. FUEL AND GAS ANALYSIS. In this course the efficiency of the firing of boilers is studied by analysis of the fuels used. Samples of the flue gases taken during boiler laboratory tests are analyzed by means of the Orsat-Muencke and Hempel apparatus, and the lubricating oils employed are also tested. Juniors in Mechanical

and Chemical Engineering; two hours, second semester.

51. OIL AND GAS ANALYSIS. In this course the student determines the nature of oils by means of specific gravity, maumene number, Köttstorfer, Reichert, Hehner, iodine value, etc. Gas analysis consists in determining the percentage composition of illuminating gas, furnace gases, and air. *Optional* for students who have had Course 44 or 45; six hours, first semester.

52. THERMO-CHEMISTRY. In this course, the principles governing the transformation of chemical energy into heat and of this and other forms of energy into chemical energy are given. The heat of formation of chemical compounds is measured experimentally and the application of the principles of thermodynamics to the electrolytic production of chemical compounds is discussed. Seniors in Chemistry and Chemical Engineering, and Sophomores in Mechanical Engineering; two hours, second semester.

53. WATER ANALYSIS. In this course the suitability of various waters for drinking purposes and for use in boilers is determined. The chemical examination of potable waters is supplemented by a bacteriological examination, and methods for adapting waters for manufacturing purposes are discussed. In the laboratory work of this course, students are privileged to carry

out the regular tests in the laboratory of a leading water expert. Juniors in Chemistry, Seniors in Chemical Engineering, Sophomores in Civil Engineering; three hours, second semester.

54. MEDICAL CHEMISTRY. This course is primarily intended for those who intend to become analytical chemists. No attempt is made to connect the results of analysis with medical diagnosis, the subject being considered from its chemical rather than its medical side. *Optional* for students who have had Courses 41 and 44; six hours, first semester.

55. CHEMISTRY OF FABRICS. In this course, cotton, silk, wool, and other fabrics are examined partly by microscope and partly by chemical tests. The nature of the dyestuffs used is also determined as far as possible. *Optional* for Seniors in Chemistry; six hours, second semester.

56. ADVANCED INORGANIC CHEMISTRY. This course covers the general ground indicated by Richter's "Inorganic Chemistry." *Optional* for students who have had Course 40; two hours, either semester.

57. ASSAYING OF GOLD AND SILVER. An experimental course intended to familiarize the student with assaying gold and silver bullion, and also the preparation and estimation of the precious metals in their ores. *Optional* for Juniors

and Seniors in Chemistry; six hours, second semester.

58. ELECTROLYSIS AND ELECTRO-SYNTHESIS OF ORGANIC COMPOUNDS. An experimental course in which the student becomes familiar with the action of the electric current upon solutions of inorganic salts, followed by a study of the action of the current in forming typical organic substances. *Optional* for Seniors in Chemistry; six hours, first semester.

59. DETERMINATION OF MOLECULAR WEIGHTS. An experimental course in the determination of molecular weights by the methods of Hoffman, Meyer, Dumas, Raoul, and Beckman. Written reports on this course are required weekly. *Optional* for Juniors in Chemistry; six hours, second semester.

60. SANITARY AND INDUSTRIAL WATER SUPPLY. A course of lectures on the chemistry, biology, filtration, and purifying of water, the relation between water supplies and the public health, and various methods of sewage disposal. Seniors and Graduate Students in Chemistry; twelve hours.

61. SHELLAC, VARNISHES, AND GLYCERINE. A course of lectures dealing with the origin, preparation, uses, and tests for purity, of varnish products and shellac; as well as the sources, analysis, valuation, refining, distillation, evaporation,

decolorization, and uses of glycerine. Seniors and Graduate Students in Chemistry; six hours.

62. **FOODS AND THEIR ADULTERATION.** A course of lectures giving the relation of Chemistry to foods and beverages and to health, and involving a consideration of metabolic processes, digestion, assimilation, excretion, composition, and adulteration. Seniors and Graduate Students in Chemistry; twelve hours.

63. **GENERAL TECHNICAL CHEMISTRY.** A course of lectures dealing with such subjects as fuels, wines, tartar-products, leavening agents, and industrial wastes and their utilization. Senior and Graduate Students in Chemistry; ten hours.

64. **THESIS FOR THE DEGREE OF BACHELOR OF SCIENCE OR CHEMICAL ENGINEER.** The completion of the chemical or chemical engineering course requires the preparation of a thesis, the fruit of original investigation carried on with the advice and assistance of the professors, and demanding both experimental research and constant reference to current scientific literature. Seniors in Chemistry and Chemical Engineering; fifteen hours, both semesters.

65. **ADVANCED ORGANIC CHEMISTRY.** The synthesis of organic compounds, perfumes, ethers, and lakes. The preparation of coal-tar dyes;

their action upon mordants and with bleaching agents. Electro-synthesis ; the application of oxidation and reduction by electric current to organic compounds. Graduate students ; ten hours, both semesters.

66. **ADVANCED INDUSTRIAL CHEMISTRY.** The application of chemical processes on a large scale. The preparation of phosphatic fertilizers. Pigments and tests for their purity. Laboratory work on the utilization of waste products. Graduate students ; twenty hours, both semesters as a major subject ; ten hours, both semesters as a minor.

67. **ADVANCED INORGANIC CHEMISTRY.** Determination of vapor densities by the methods of Hoffman, Dumas, and Meyer ; and of molecular weights by conductivity methods. The study of thermal effects in chemical reactions. Graduate students ; ten hours, both semesters.

III. CIVIL ENGINEERING

PROFESSOR SPOFFORD, PROFESSOR WHIPPLE, MR. CODWISE, MR. ADAMS, MR. LJUNG, MR. BARLOW, MR. PICKERSGILL, MR. SMITH, AND MR. TUTHERLY.

70. **SURVEYING AND PLOTTING.** This is a lecture course upon the construction, adjustment, and use of the chain, tape, compass, level, transit, and other appliances employed in ordinary

surveying, supplemented by one day's field or office work each week. The work in the field includes individual practice with these instruments under the personal supervision of the instructor, and the making by the class of pacing, compass, transit and topographical surveys. The office work consists of the making of a finished topographical map from notes obtained in the field, and of the solution of numerous problems arising in the work of the surveyor. Sophomores in Civil Engineering; eight hours, first semester; six hours, second semester.

71. RAILROAD CURVES AND EARTHWORK. A theoretical course upon the computation of curves and earthwork. The mathematical problems involved are discussed at length, and their practical application is enforced by the solution of many special field problems, in addition to the field work of Course 75. The methods of staking out earthwork and of estimating cut and fill are thoroughly considered. Juniors in Civil Engineering; two hours, both semesters.

72. RAILROAD SURVEY AND DRAWING. A complete survey of a proposed railroad line not less than one mile in length. A location is chosen on rolling land within easy reach of the city, and a reconnaissance of the region between the terminals is made for the purpose of indicating to the student the governing elements in the prob-

lem. This is followed by a preliminary survey, and from the data thereby obtained the location is decided upon and the final line staked out; a map is drawn and an estimate made of the cut and fill. Juniors in Civil Engineering; six hours, first semester.

73. SUMMER SCHOOL. A summer school of surveying is held each year in the two weeks immediately following commencement. Attendance is required of the Sophomores and Juniors in Civil Engineering. The location is varied from time to time as may seem desirable, but the school is usually held within one hundred miles of the city. The work consists of a topographical survey of a given district, based upon a system of triangulation, in the carrying out of which the student obtains practice in base line measurements, in the field and office work of triangulation, and in hydrographic surveying. Sophomores and Juniors in Civil Engineering; two weeks.

74. TOPOGRAPHICAL DRAWING. Elementary exercises in the conventional methods of representation both with pen and colors, involving the delineation of rivers and harbors, marshes, woodland, cultivated fields, and the like. Sophomores in Civil Engineering; two hours, second semester.

75. HYDRAULIC MEASUREMENTS. This is primarily a field course, intended to illustrate the common methods of gaging stream flow. The observations made in the field are graphically recorded, and computations of the discharge made. Seniors in Civil Engineering; two hours, first semester.

76. ADVANCED SURVEYING. This course is a continuation of Course 70. The theory of the stadia, plane table, solar compass, and sextant are explained in the lecture room, and illustrated by practice in the field. Juniors in Civil Engineering; four hours, second semester.

77. THEORY OF STRUCTURES. An elementary course in which a thorough study is made of the methods of determining reactions, shears and moments in roofs and bridges. Special attention is given to the consideration of moving loads. Juniors in Civil Engineering; two hours, second semester.

78. PRACTICAL ASTRONOMY. A study of spherical astronomy as applied to the determination of latitude, longitude, time, azimuths, altitudes and general problems of spherical astronomy, with calculations of apparent positions, as observed by the student by means of the sextant, with both artificial and natural horizon, field transits, the equatorial telescope, and a transit

instrument. Juniors in Civil Engineering; two hours, second semester.

79. LAW OF CONTRACTS. A study of the law of contracts so far as it is especially serviceable to engineers, from text-books prepared for such use. Seniors in Civil and Mechanical Engineering; one hour, first semester.

80. FOUNDATIONS. A course devoted to the study of the methods of constructing foundations for bridges, buildings and other structures. Seniors in Civil and Mechanical Engineering; one hour, second semester.

81. THEORY OF STRUCTURES. This course is a continuation of Course 77. It comprises the computation and design of structures of wood, steel, concrete and stone. Analytical and graphical methods are both given at length. The following structures are discussed: Simple beams and trusses, plate girders, draw spans, cantilevers and arches, suspension bridges, retaining walls, and dams. The course is considered to be of great importance in firmly fixing upon the student's mind the laws of mechanics and a knowledge of the working strength of the different materials, and in training him in logical methods of solving engineering problems. Seniors in Civil Engineering; four hours, both semesters.

82. MECHANICS OF MATERIALS. A study of the relation between stresses and strains, and of

the common theories of flexure, torsion, column action and riveted joints. The elastic limit, working, and ultimate strength of the materials of engineering are considered at length, and methods of figuring reactions, moments and shears in single and continuous beams under fixed loads are thoroughly discussed. Many problems are assigned covering the various points treated, and especially the design of beams, columns, and torsion members. Juniors in Engineering; three hours, first semester.

83. TESTING MATERIALS. A laboratory course in which the students collectively and individually determine the strength of wood, iron, steel, bronze, cement, and stone. The observations and incidental calculations are entered in the standard note books, the results being reported upon printed forms for inspection. Juniors in Engineering; three hours, first semester.

84. FRAMED STRUCTURES. This is a course intended to satisfy the requirements of electrical and mechanical engineers, who are frequently called upon in their professional capacity to design simple beams, girders, roof trusses, etc. The methods of computation and design of such structures are discussed, and many problems assigned. Seniors in Mechanical and Electrical Engineering; three hours, first semester.

85. BRIDGE DESIGN. This course supplements

Course 81, and is intended to enforce the principles learned in that course by applying them to practical problems. The first problem assigned is the design of a plate girder bridge. The student figures the stresses for a concentrated wheel load system, designs the members, makes a complete shop drawing of the entire bridge, and estimates the weight and cost, his work being carefully checked at every stage. Following this a wooden roof-truss or bridge is designed, and then a steel truss. In this latter problem the members are not all worked out in full, but typical joints are detailed carefully, and the arrangement of the members at all the joints, the size of pins, and similar details shown. A different problem is assigned to each student, and as the work is done under the direct supervision of the professor in charge, independent work is assured. This course is supplemented by visits to important bridges and bridge works. Seniors in Civil Engineering; six hours, both semesters.

86. PUBLIC WATER SUPPLIES. A course treating of the requirements and sources of a municipal water supply, and of the construction of water works. The quantity of water needed and the sources of supply with the factors which influence them are first considered. This is followed by a discussion of the importance of good quality, the transmission of disease germs by

water, and the relative merits of different sources of supply. The construction of works for the collection of water is next taken up, and problems affecting the location, size and construction of wells, infiltration galleries, impounding reservoirs, and filtration plants are considered. The final subject treated is the design of the distribution system, under which heading are considered the various problems pertaining to aqueducts, pipe lines, distributing reservoirs, stand pipes, hydrants, and street mains. Visits are made to nearby water works, and the course is supplemented by Course 373, which is given simultaneously, and by Course 88. Seniors in Civil Engineering; four hours, first semester.

87. SEWAGE AND IRRIGATION. This course is divided into two parts. Part A treats of the drainage of buildings and lands, sewage treatment and disposal, and the design of sewerage systems. Part B deals with problems of irrigation in this and other countries. Methods of construction and operation of irrigating systems are considered, and attention given to the arrangement and design of diversion weirs, canals, regulators and other works. Seniors in Civil Engineering; four hours, second semester.

88. SANITARY AND HYDRAULIC DESIGN. This is a drawing room course in which the student solves problems in design from assigned data.

The problems considered are the preliminary design of a sewer system, or of a water distribution system for a small town; the design of the cross section of a large sewer; and the design of a masonry dam. Each student is assigned a different problem, and the work is under the constant supervision of the instructor. Seniors in Civil Engineering; six hours, second semester.

89. HIGHWAY ENGINEERING. Survey and location of streets and roads, drainage and grades. Study of the materials and methods of construction and the machinery and tools used in construction and maintenance. Calculations of the cost of construction and maintenance. Inspection of the streets and pavements of this and neighboring cities. Juniors in Civil Engineering; two hours, second semester.

90. THESIS FOR THE DEGREE OF CIVIL ENGINEER. An original research design or solution of an actual engineering problem, which must show conclusive evidence of the student's ability to make use of the knowledge gained in his studies in attacking and successfully solving new problems. Seniors in Civil Engineering; six hours, second semester.

91. HIGHER STRUCTURES. This course treats of the computation and design of the more complicated structures not considered at length in

Course 81, such as suspension bridges, two-hinged arches, and continuous girders. The application of the theorem of least work and of other modern methods to the solution of such problems is considered at length. The course is primarily a lecture course, but a considerable proportion of the student's time is allotted to the reading of technical papers under the guidance of the Professor in charge. Graduate Students in Civil Engineering; total of one hundred and twenty hours in two semesters.

92. ADVANCED BRIDGE DESIGN. A drawing room course extending the work of Course 85. The student is required to design, estimate the weight, and make stress sheets and general drawings of not less than two structures of considerable size, one of which must be of the riveted type and one of the pin type. This work is done under the direct supervision of the professor in charge, whose approval must be obtained upon all essential points. The course is considered very valuable for one wishing to specialize in structural engineering. Graduate Students in Civil Engineering; total of one hundred and eighty hours in two semesters.

93. HYDRAULIC ENGINEERING. This course is a continuation of Course 372 in hydraulics. It takes up more thoroughly the flow in open channels and conduits, showing the various losses

and how to avoid them, deals with the flow in rivers, water power, showing the location and development of water power plants, design of water wheels and turbines, and commercial tests on various types of hydraulic motors. The aim of the course is to make the student familiar with the various branches of hydraulic engineering, and to teach him to apply what he has learned to the solution of actual problems. Graduates in Civil Engineering; three hours, both semesters.

94. RAILROAD ENGINEERING. A course treating of the economics of railroad location, maintenance of way problems, equipment, organization and management of steam and street railroads. Graduate Students in Civil Engineering; two hours, both semesters.

IV. EDUCATION*

PRESIDENT ATKINSON, PROFESSOR EDSON, AND MR. LITTLE.

100. HISTORY OF EDUCATION. A study of the growth of educational ideals and institutions from the time of the Greeks, with a view to considering present educational problems in the light of their historic unfolding. This course in-

* For other and allied courses in Education, see Department of Philosophy, p. 196, and Department of Political and Social Science, p. 200.

volves some examination of the great classics of educational literature, as well as an attempt to co-ordinate social and political forces with the development of the various ideals and schools. *Elective* for Juniors and Seniors in Arts; *optional* for Sophomores in Arts; two hours, second semester; *required* of students of the Course in Pedagogy; thirty hours.

101. PRINCIPLES OF EDUCATION. An exposition of the principles underlying the art of teaching, historically derived and applied to contemporary problems. Some attention is devoted to the European national systems with a view to determining the contributions they may make to organized education in the United States. *Elective* for Juniors, Seniors, and Graduates in Arts; two hours, first semester; *required* of students of the Course in Pedagogy; thirty hours.

102. PHILOSOPHY OF EDUCATION. A study of the aims and function of education from the philosophical standpoint, considering applications to it of psychology, its ethical aspects, and its relation to evolution. *Elective* for Seniors in Arts and Graduate Students; one hour, both semesters; *required* of Students of the Course in Pedagogy; thirty hours.

103. EDUCATIONAL MASTERPIECES. A course involving the study of the classics of education as reflecting educational ideals in ancient and

modern times. Lectures upon periods and topics not easily studied at first hand are supplemented by reports upon assigned readings, and discussions upon the practical bearing of the theories considered. Works of Plato, Aristotle, Xenophon, Quintilian, Plutarch, Milton, Rousseau, Spencer, and others are critically examined. *Elective* for Juniors and Seniors in Arts and Graduate Students; one hour, both semesters; *elective* for students of the Course in Pedagogy; thirty hours.

104. SCHOOL ORGANIZATION AND ADMINISTRATION. A course dealing in detail with the problems of educational administration and supervision. It discusses the relations of the executive officer to the public, the school board, the teacher and the pupil, considering such matters as the program of studies, grading, examinations, promotions, record-keeping, prizes, the social life of the school, play, the proper construction and care of buildings, the function of the teachers' meeting, and financial requirements. The inspection of a number of schools will form a part of this course. *Elective* for Seniors in Arts and Graduate Students; one hour, both semesters; and *elective* for students of the Course in Pedagogy; thirty hours.

105. GENERAL METHODS OF TEACHING. A course dealing with the sources and philosophical

basis of present educational practice, attention being centered upon general methods applicable in the teaching of all branches. *Elective* for Seniors in Arts and Graduate Students; one hour, both semesters; Students of the Course in Pedagogy; thirty hours.

106. CURRICULUM AND METHODS OF ELEMENTARY SCHOOL TEACHING. A course dealing with the program of study and methods of instruction adapted to the elementary grades, and involving both observation of class work and practice teaching. *Elective* for Seniors in Arts and Graduate Students; two hours, first semester; *required* of Students of the Course in Pedagogy; thirty hours.

107. SPECIAL METHODS. A course provided by the departments of Greek, Latin, English, German, French, History, and Mathematics, dealing with approved methods of teaching these special branches in the Secondary School. *Elective* for Seniors in Arts and Graduate Students; two hours, second semester; *elective* for Students of the Course in Pedagogy; thirty hours.

V. ELECTRICAL ENGINEERING

PROFESSOR SHELDON, PROFESSOR PERRINE, PROFESSOR MAILLOUX, PROFESSOR MERSHON, PROFESSOR STEINMETZ, AND MR. ASHE.

130. MATERIALS OF ELECTRIC CONSTRUCTION. A lecture and laboratory course in which the phys-

ical properties of materials of electric construction are considered. Their limitations and methods for testing them. Juniors in Electrical Engineering; one hour, first semester.

131. DYNAMO ELECTRICITY. The theory of the operation and design of dynamo electrical machinery, together with a discussion of the elements affecting its regulation when in operation. The more advanced laws of magnetism and the magnetic properties of iron and steel are also treated. Juniors in Electrical, Mechanical, and Chemical Engineering; three hours, second semester.

132. DYNAMO LABORATORY. A course involving a series of tests on the construction, regulation, efficiency, and operation of direct current dynamos and motors, together with a consideration of the efficiency and distribution of light, and the candle power of arc and incandescent lamps. Juniors in Electrical Engineering; six hours, second semester; Juniors in Mechanical and Chemical Engineering; one hour, second semester.

133. ALTERNATING CURRENTS. A complete discussion of the laws affecting the flow of alternating currents through circuits containing resistance, capacity, and inductance, either in combination or singly, together with a study of the theory of the construction and the operation of

alternating current dynamos as well as of the laws governing the actions of the alternating current transformer, of the induction and synchronous motor and of the converter. Seniors in Electrical Engineering; three hours, first semester.

134. ALTERNATING CURRENT LABORATORY. A course involving general tests on the operation and regulation of single phase and polyphase generators, of synchronous and induction motors, and of converters, and requiring a number of experiments of a quantitative character for the purpose of illustrating the phase relations which exist in circuits where the current lags behind or leads the electro-motive force, as well as tests of the hysteresis losses in various kinds of iron. Seniors in Electrical Engineering; nine hours, first semester.

135. TELEPHONY, TELEGRAPHY, AND PATENT PRACTICE. A consideration of the speaking telephone, users' instruments, lines, cables, equipment, and arrangement of central stations, exchange switchboards, party lines and selective call signal systems; an examination of systems; an examination of systems of land and submarine telegraphy; and a short discussion of inventions, patents, and patent practice. Seniors and Graduate Students in Electrical Engineering; one hour and reports, second semester.

136. ELECTRIC TRACTION. A course of lectures on load and cost factors, on car and train resistance, on track construction, on interurban roads and city tramways, on conduit and special sectional roads, on the characteristics of railway motors, on schedules, on motor capacity and gear ratio, on braking, and on the economics of electric railroading. Seniors and Graduate Students in Electrical Engineering; one hour and reports, second semester.

137. ELECTRICAL POWER TRANSMISSION. A course of lectures treating of the economics of transmission problems, of investigations concerning waterflow and watershed, of high and low head hydraulic machinery, of electrical machinery adapted to long-distance power transmission, of the proper location and construction of transmission lines, of high and low tension distribution, and of transmission from coal and gas fields. Seniors and Graduate Students in Electrical Engineering; one hour and reports, second semester.

138. ELECTRICAL DESIGN. A practical course involving the complete electrical and mechanical designing of electrical apparatus, requiring of each student the preparation of working drawings of a piece of direct current and a piece of alternating current apparatus. Seniors in Electrical Engineering; two hours, both semesters.

139. ELECTRIC LIGHTING. A consideration of the characteristics and operation of arc and incandescent lights together with the properties of conductors and various systems of electrical distribution for purposes of illumination, including direct currents as well as single and polyphase currents. Seniors in Electrical Engineering; two hours, second semester.

140. COMMERCIAL ELECTRICAL ENGINEERING. A brief consideration of the training and qualifications of a commercial electrical engineer, of the design, construction, and testing of electrical machinery in large manufacturing companies and the work of engineer salesmen. Seniors and Graduate Students in Electrical Engineering; one-half hour and reports, first semester.

141. CENTRAL STATION PRACTICE. A course of lectures on the conditions governing the selection of a system, on the arrangement and installation of the steam and electric plant, on switchboards, on distributing systems, on metering, and on the organization and management of a plant. Seniors and Graduate Students in Electrical Engineering; one hour and reports, first semester.

142. THESIS FOR THE DEGREE OF ELECTRICAL ENGINEER. An original and individual investigation involving both theoretical and practical research, and purposing, where possible, to determine the constants entering into some general

law or into the operation of some specific device of practical value to the engineering profession. Seniors in Electrical Engineering; ten hours, first semester; fifteen hours, second semester.

143. ELECTRICAL RESEARCH LABORATORY. Experimental investigations in the new fields of electrical research from the scientific as distinguished from the technical standpoint. *Elective* for Graduate Students; ten hours, first semester.

144. ADVANCED ELECTRICAL ENGINEERING DESIGN. The design-calculations, with working drawings, of a manufacturer's line of standard machines. *Elective* for Graduate Students; five hours, first semester.

VI. ENGLISH AND COMPARATIVE LITERATURE

PROFESSOR CHANDLER, PROFESSOR COLLINS, MR. STREUBEL,
MR. GOLDEN, AND MR. DUNCAN.

A. RHETORIC AND ORATORY.

160. PRINCIPLES OF RHETORIC. The theory of rhetoric, with themes and frequent exercises in extemporaneous writing in the class-room. Especial attention is given to the development of the paragraph and the essentials of exposition, description, and narration. All Freshmen; two hours, first semester.

161. MODERN ENGLISH PROSE AND COMPOSITION. A course involving the reading of selected works of essayists and novelists of the nineteenth

century, together with constant practice in composition. Among the authors considered are Lamb, DeQuincey, Macaulay, Carlyle, Ruskin, Newman, Emerson, Arnold, Pater, Scott, Dickens, Thackeray, Eliot, Poe, Hawthorne, Stevenson, and Meredith. Written class exercises, critical reports, and themes in emulation of the style of great masters are required. All Freshmen; three hours, second semester.

162. TECHNICAL ENGLISH. A course of composition involving the writing of scientific articles, descriptions of machines and devices, and reports upon laboratory experiments, lectures, and engineering problems with a view to facilitating clear, correct, and concise expression. This course is conducted in part by class exercises, but largely by conferences, and so far as possible the actual technical work of the student is made its basis. Juniors in Chemistry and Engineering; one hour, both semesters.

163. ARGUMENTATIVE COMPOSITION. The theory and practice of argumentative composition, including the analysis of famous speeches, the preparation of orations and of briefs for debates, with the criticism of original exercises. *Elective* for Juniors in Arts; one hour, first semester.

164. LITERARY FORMS. A critical and practical study of composition, including the art of versification, and involving the preparation and

discussion of original exercises in prose and verse. *Elective* for Juniors and Seniors in Arts; one hour, first semester.

165. SPECIAL COMPOSITION. A course consisting wholly of theme writing and consultations, required at any time after the Freshman year of students who show inability to write clear and correct English. Hours devoted to this subject may not be counted toward a degree, but the course is obligatory upon any student when recommended by the Professor of English and approved by the President.

166. ORATORY. An elementary course in the principles and practice of effective reading and speaking, declamatory and dramatic. *Optional* for Freshmen and Sophomores; one hour, second semester.

167. DEBATES. A course in practical debating. All Freshmen; one hour, first semester.

168. ADVANCED ORATORY. The reading and speaking of masterpieces of English prose and verse, with the preparation and delivery of orations. *Optional* for Juniors and Seniors in Chemistry and Engineering; *elective* for Juniors and Seniors in Arts; one hour, both semesters.

B. ENGLISH LANGUAGE AND LITERATURE.

175. CHAUCER AND THE ENGLISH LANGUAGE. Outline of the development of the English lan-

guage with especial reference to the sources of its vocabulary, its grammatical changes, and a history of its prefixes, suffixes, and synonyms, and word analysis and word-building; together with the reading of selections from Chaucer. All Freshmen; two hours, first semester.

176. OUTLINE OF ENGLISH LITERARY EPOCHS. A general historical view of English Literature in its more significant periods, and in representative masterpieces with some consideration of the function of literature and the development of its typical forms. A text-book is used as the syllabus of this course, but the reading of assigned works, the writing of essays, and the lectures constitute its more important features. All Sophomores; two hours, both semesters.

177. SHAKESPEARE. A somewhat detailed study of the more important plays of Shakespeare, several being considered in their textual, linguistic, and historical features, but chief emphasis throughout being laid upon appreciation of them as literature and an interpretation of life. Freshmen in Arts; three hours, second semester.

178. LITERATURE FROM SPENSER TO POPE. Studies in literature from the Renaissance through the Restoration, presenting a survey of the development during this period of drama, epic, lyric, romance, and essay. Historical in-

fluences, typical writers and works, and the general movements of thought are considered. The course includes the reading of the plays of Shakespeare not discussed in Courses 176 and 177. Sophomores in Arts; three hours, first semester.

179. EIGHTEENTH CENTURY LITERATURE. A view of the progress and interpretation of English letters during the Augustan period, with particular emphasis upon classicism, the rise of the essay and the novel, and the early romantic movement. The general development of English thought in the eighteenth century is also considered. Sophomores in Arts; three hours, second semester.

180. NINETEENTH CENTURY LITERATURE. A review of literary achievement from the publication of the Lyrical Ballads of Wordsworth and Coleridge to the death of Tennyson, dealing with individual writers and with significant tendencies of the epoch; the democratic and dictional reform, the substitution of Greek for Latin, and German for French influence, the new interpretation of nature, the growth of interest in the old English writers, and the influence of the scientific spirit upon letters. The development of the essay and prose fiction is traced, but chief stress is laid upon the poetry of the century. Juniors in Arts; three hours, first semester.

181. THE ENGLISH NOVEL. A study of the development of English prose fiction from its beginnings to the present, with a view to ascertaining its general trend, the foreign influences it has felt, the native elements it manifests, as well as to secure acquaintance with its best examples. *Elective* for Juniors, Seniors, and Graduate Students in Arts; three hours, first semester.

182. THE ENGLISH ROMANTIC MOVEMENT. A detailed investigation into the origin and progress of the romantic movement of the eighteenth and nineteenth centuries in England, with some reference to its German and French parallels. This course involves the critical reading of large tracts of literature, as well as considerable topical research. *Elective* for Juniors, Seniors, and Graduates in Arts; three hours, second semester.

183. TENNYSON AND BROWNING. An intensive study of the two chief poets of the Victorian Era, comprising a discussion of their technique, art, growth of mind, general interpretation of life, and relation to their time. The reading of their complete works, the preparation of reports, and class conferences are involved. *Elective* for Juniors, Seniors, and Graduate Students in Arts; three hours, second semester.

184. AMERICAN LITERATURE. A survey of American verse and prose from Colonial days to the present, with the reading and discussion of

notable works, the study of British influence in American letters, and the assignment of particular periods and men for detailed individual study. *Elective* for Juniors, Seniors, and Graduate Students in Arts; three hours, second semester.

185. MIDDLE ENGLISH. A critical study of Chaucer's selected works, of his literary sources and his relation to his time, together with the presentation of a general view of literature in England from 1200 to 1500. *Elective* for Seniors and Graduate Students in Arts; two hours, second semester.

186. OLD ENGLISH. An elementary course in Old English, with a study of the grammar, the reading of selections from prose and poetry, and some consideration of the mythology and the religious and social life of the Anglo-Saxons. *Elective* for Seniors and Graduate Students in Arts; two hours, first semester.

187. THE ENGLISH ESSAY. A research course in the development of the essay with especial reference to its cultivation in England. The aim is to present a detailed and comprehensive study of this genre. *Elective* for Graduate Students; two hours, both semesters.

C. COMPARATIVE LANGUAGE AND LITERATURE.

190. SCIENCE OF LANGUAGE. A systematic study of the principles of linguistic growth, pre-

senting the psycho-physical and the historical aspects of language, the classification of language, ethnology, and methods of comparative philology. *Elective* for Juniors and Seniors in Arts; two hours, first semester.

191. COMPARATIVE STUDY OF LITERARY TYPES. A wide survey of the history and an interpretative study of the characteristic representatives of one or more of the four great literary types, the drama, the lyric, the epic, and prose fiction. Usually but one of these types is studied for the year, but its development from its origin, through the range of European literatures is traced with considerable detail, and not only the works themselves but the best commentaries upon them are read. The course is largely one of research, the lectures of the instructor being supplemented by reports upon assigned topics from the students. In so far as possible the reading is done in the original languages, but the aim of the course is above all to secure a comprehensive view of the history and evolution of some type of literature as a whole, together with an æsthetic appreciation of its notable manifestations. *Elective* for Seniors and Graduate Students in Arts; three hours, both semesters.

192. THEORY AND HISTORY OF LITERARY CRITICISM. An examination of the great critical works from the Poetics of Aristotle to the present,

with a view to determining the principles implicit in literature and all the arts. The history of literary criticism is traced so far as is necessary for an understanding of the relations of the great works; and especial attention is given to the history of literary criticism in the Renaissance. *Elective* for Seniors and Graduate Students in Arts; three hours, second semester.

193. THE COMIC. This course investigates the nature and significance of the comic in art, considering its psychology, scope and kinds, its dependence upon social and political conditions and literary movements, its national traits, and its principal manifestations in the work of individuals, determined through an examination of European letters. Attention is also paid to the evolution of the forms of comic literature—jest, epigram, burlesque, satire, conte, comic romance, comedy; and incidentally the influences exerted by masterpieces of the comic are traced. *Elective* for Graduate Students; two hours, both semesters.

194. LITERARY RELATIONS BETWEEN ENGLAND AND GERMANY. A course of research investigating, first, the influence of English literature upon German in the seventeenth and especially the eighteenth century, and secondly, the return influence of German literature in England in the nineteenth century. This study of the mutual

dependence of the two countries is related to the literary and philosophical movements in both. *Elective* for Graduate Students; two hours, both semesters.

195. OLD TESTAMENT THEMES IN MODERN LITERATURE. A course of research investigating the literary treatment accorded Hebrew legend and history in Europe from the mediæval drama to the present time. The development of individual themes is traced in various literatures with a view to ascertaining how they have been modified by personal and national elements as well as by the trend of modern thought; and the whole contribution is estimated as one of the three main sources of modern literary inspiration, chivalric, classic, and Hebraic. *Elective* for Graduate Students; two hours, both semesters.

VII. FRENCH

PROFESSOR CARTEAUX.

200. NINETEENTH CENTURY FRENCH. A course involving the rapid review of French syntax, exercises in idioms, practice in prose composition and conversational drill upon literary and historical topics and current events, together with a special study of nineteenth century French literature in the works of representative authors. Freshmen in Arts electing French; three hours, first semester; two hours, second semester.

201. SCIENTIFIC FRENCH. A course involving the rapid review of French syntax, exercises in idioms, practice in prose composition and conversational drill upon scientific topics, together with the reading of selected scientific monographs. Freshmen in Engineering and Chemistry electing French; two hours, first semester; three hours, second semester.

202. CLASSICAL FRENCH. A study of seventeenth century French literature, with especial reference to the drama in the works of Corneille, Racine, Molière, and to prose in the works of Bossuet, Fénelon, and Pascal. Sophomores in Arts, Chemistry, and Chemical Engineering, and such Freshmen as have passed the advanced entrance examination in French; three hours, first semester; two hours, second semester.

203. OUTLINES OF FRENCH LITERATURE. A study of the history of French literature from the Renaissance to the present, tracing the development of poetry, the drama, history, political and religious prose, and general letters. *Elective* for Juniors in Arts and Sophomores in Arts who have had Course 202 or an equivalent; two hours, first semester; three hours, second semester.

204. MEDIAEVAL FRENCH. A study of the French language and literature from its origins to the Renaissance, with the critical reading of

such typical works as Villehardouin's Chronicle, Joinville's Saint Louis, Jean de Meung's Roman de la Rose, Froissart's Chronicles, Montaigne's Essays, and the poetry of Marot and Marguerite de Navarre. This course includes lectures upon the literary and linguistic history of the period, and involves also individual French. *Elective* for Seniors in Arts and for students who have had Course 203 or an equivalent, and *optional* for scientific students who have a sufficient command of spoken French; two hours, both semesters.

205. CONVERSATIONAL FRENCH. Practical exercises in modern French, comprising conversation upon topics of daily life and current events, in connection with readings from French periodicals and dictation for sight translation and reproduction. *Optional* for all students who are acquainted with the essentials of French grammar and possess some vocabulary; two hours, both semesters.

206. THE FRENCH NOVEL. A course presenting the development of prose fiction in France with especial reference to the French novel of the nineteenth century in its various types and representative masters. Attention is focussed upon De Vigny, Hugo, Dumas, Sand, Feuillet, Balzac, De Maupassant, Daudet, and Zola. *Elective* for Graduate Students; two hours, both semesters.

207. THE FRENCH THEATRE. A study of the origin and growth of the French drama with particular emphasis upon the classical period. Attention is also devoted to the social and literary influences exerted upon French tragedy and comedy. *Elective* for Graduate Students; two hours, both semesters.

208. FRENCH PROSE OF THE SEVENTEENTH AND EIGHTEENTH CENTURIES. A course dealing with the great prose writers of France prior to the nineteenth century. It involves a consideration of the religious, moral, philosophical, and political writings of the period and considers the social and literary movements of both centuries. *Elective* for Graduate Students; two hours, both semesters.

VIII. GERMAN

PROFESSOR COLLINS AND MR. SCHWARZ.

220. INTRODUCTORY GERMAN. A course involving a rapid review of the fundamental principles of German grammar, some study of derivation, the mastery of the main facts of consonant mutation, and the translation of prose texts of moderate difficulty and of representative lyric poems, together with exercises in prose composition and conversational drill. Freshmen in Arts electing German; two hours, first semester; three hours, second semester.

221. SCIENTIFIC GERMAN. A course involving a rapid review of German syntax, exercises in idioms, prose composition and conversational drill directed towards acquiring a copious scientific vocabulary, together with the reading of selected scientific monographs. Freshmen in Chemistry and Engineering electing German; three hours, first semester; two hours, second semester.

222. MODERN GERMAN PROSE. A study of the prose writers of the classical and the modern period, with especial reference to the historians, and involving some consideration of the development of German literature. This course requires also the translation from English into German of long selections, the frequent reproduction in the student's own words of the texts read, and ample conversational drill. Sophomores or Freshmen in Arts, Chemistry, and Chemical Engineering, who have passed the advanced examination in German for admission; *optional* for Scientific Freshmen who have passed the same examination, or Scientific Sophomores who have had Course 221 or an equivalent; two hours, first semester; three hours, second semester.

223. OUTLINES OF GERMAN LITERATURE. A study of the history of classical and modern German literature from German text-books, supplemented by extensive reading, and embracing the critical examination of Faust and other master-

pieces, with lecture-commentary in German and the preparation of essays in German based upon class-readings and individual research. *Elective* for Juniors in Arts and Sophomores in Arts who have had Course 222 or an equivalent; three hours, first semester; two hours, second semester.

224. EARLY GERMAN. A review of the history of the origin and early development of the German language and literature, involving a study of elementary Middle High German grammar, the reading of selections from Middle High German texts, the preparation of essays based upon individual research, including lectures and colloquies in German upon the subjects discussed. *Elective* for Seniors in Arts and for Juniors who have had Course 223; *optional* for scientific students who have a sufficient command of spoken German. Two hours, both semesters.

225. CONVERSATIONAL GERMAN. Practical exercises in Modern German, comprising conversation upon topics of daily life and current events, in connection with readings from journalistic German and dictation for sight translation and reproduction. *Optional* for all students who are acquainted with the essentials of German grammar and possess some vocabulary; two hours, both semesters.

226. MEDIAEVAL GERMAN EPIC AND LYRIC. A study of the sources and treatment of the Min-

negesang; together with an investigation of the origin and composition of the various Saga Cycles. *Elective* for Graduate Students; three hours, both semesters.

227. OLD HIGH GERMAN. A study of Old High German grammar, together with a critical reading of selected texts and consideration of the metrical forms. *Elective* for Graduate Students; two hours, both semesters.

228. GOTHIC. A course in comparative grammar with especial reference to Ulfilas' translation of the Gospels into Gothic. *Elective* for Graduate Students; two hours, both semesters.

229. LUTHER. Luther's services to the German language and literature with an examination of the merits of his contemporaries. *Elective* for Graduate Students; two hours, both semesters.

230. LESSING. A detailed study of Lessing's activity as reformer and critic, especially of the drama. *Elective* for Graduate Students; three hours, both semesters.

231. HERDER. An estimate of Herder's influence on the classic and post-classic literature of Germany. *Elective* for Graduate Students; three hours, both semesters.

IX. GREEK *

PROFESSOR HAWES.

240. XENOPHON OR LYSIAS. A course of reading, accompanied by work in grammar. In reading the orations of Lysias particular attention is given to social and political references. Freshmen in Arts electing Greek; three hours, first semester.

241. HOMER. Selected books of the Odyssey are read, the study of Homeric characters is taken up by means of lectures, and portions of the poem, other than those assigned, furnish the basis of sight reading. Freshmen in Arts electing Greek; and *elective* for other Arts students; three hours, second semester.

242. DEMOSTHENES. This course of reading in Demosthenes on the Crown is intended to give the student an insight into Greek oratorical arrangement and style. Greek history and the manners of the times are investigated by means of lectures and collateral reading. Sophomores in Arts electing Greek; and *elective* for other Arts Students; three hours, first semester.

* Provision for those who desire to begin the study of Greek is made by arrangement with the Polytechnic Preparatory School; but such elementary courses are optional and may not be counted toward a degree.

243. THEOCRITUS AND ARISTOPHANES. In connection with the reading of selected Idylls some study of Alexandrian literature in its historical development is made. Aristophanes' *Frogs* provides the basis for a study of Greek comedy. Sophomores in Arts electing Greek; and *elective* for other Arts Students; three hours, second semester.

244. ÆSCHYLUS, SOPHOCLES, PLATO. A course in Greek drama in which the Agamemnon and Antigone are read and attention is given to the similarity and differences between the classical and the modern drama. The study of Plato aims to emphasize the prominent features of Greek philosophy. *Elective* for Juniors and Seniors in Arts; two hours, both semesters.

245. GREEK LYRIC POETRY. Lectures upon and readings in the Greek lyric poets from Alkman to Timotheos. *Elective* for Graduate Students; two hours, both semesters.

246. POETICS OF ARISTOTLE. A course involving the reading and discussion of the text of the Poetics and studies in literary criticism among the Greeks. *Elective* for Graduate Students; two hours, both semesters.

X. HISTORY.

PROFESSOR GREEN AND MR. BEATMAN.

260. MEDIAEVAL HISTORY. A study of political and social conditions in Continental Europe from the migration and settlement of the Teutonic tribes to the Renaissance, dealing with the Christianization of the Barbarians, their fusion with the Latins, the fortunes of the Roman Empire in the East, the rise of the Saracens, the restoration of the Roman Empire in the West, the expeditions of the Northmen, the culmination and the decline of the temporal power of the papacy, the origin and progress of feudalism, the crusades, the free cities, the revival of learning, and the formation of national governments and literatures. This course presupposes a general knowledge of the history of Greece and Rome. Freshmen in Arts; three hours, second semester.

261. HISTORY OF MODERN EUROPE. A general survey of European history from the Reformation to the present, treating in outline the more significant political and intellectual movements, and in detail such epochs as do not constitute the particular subject of the more advanced courses in French and English history. This course is intended to orient the student as regards the history of Europe since the Reformation, and also to serve as a basis for the more specialized

work to follow. Sophomores in Arts; three hours, first semester.

262. RECENT EUROPEAN HISTORY. A course of lectures and reading dealing with the development of the chief European nations since the commencement of the French Revolution, with a view to emphasizing the principal features of contemporary world politics. Sophomores in Chemistry and Engineering; two hours, first semester.

263. HISTORY OF THE RENAISSANCE AND THE REFORMATION. A study of the origin in Italy and Germany of the modern spirit, illustrated by the progress of literature and art through the fourteenth and fifteenth centuries. The course treats of the relation of the classical revival to the Reformation, of Luther's life and work, of the Catholic reaction, of the Tudors and the Reformation in England, of the religious wars on the Continent, and involves a review of Catholic and Protestant opinion upon the results and tendencies of the reform movement. This Course or Course 264, 265, or 266 is required of Sophomores in Arts; three hours, second semester. It is *elective* for Juniors and Seniors in Arts who have not already taken it.

264. HISTORY OF FRANCE. A study of French history from the Ancien Régime to the present, with particular reference to the French

Revolution and the Napoleonic wars. The course presents in detail a view of the great events of European history from 1789 to 1815, and outlines the historical development of France before and since that period. This Course or Course 263, 265, or 266 is required of Sophomores in Arts ; three hours, second semester. It is *elective* for Juniors and Seniors in Arts who have not already taken it.

265. ENGLISH HISTORY. A study of social and political conditions in England from the Saxon period to the death of Elizabeth, treating specifically of England before the Norman conquest, of the Norman and Angevin kings, of the growth of the parliamentary constitution, of the houses of Lancaster, York, and Tudor, and of the English Renaissance and Reformation. This Course or Course 263, 264, or 266 is required of Sophomores in Arts ; three hours, second semester. It is *elective* for Juniors and Seniors in Arts who have not already taken it.

266. ENGLISH HISTORY. A study of social and political conditions in England from the death of Elizabeth to the present, treating specifically of the Puritan revolution, of the political revolution, of the rise of cabinet government, of the fall of the Whigs and the rise of the new Toryism, of the conflict with democracy, and of the growth of democracy. This Course or Course

263, 264, or 265 is required of Sophomores in Arts; three hours, second semester. It is *elective* for Juniors and Seniors in Arts who have not already taken it.

267. AMERICAN POLITICS. A course of lectures dealing with the constitutional, political, economic, social and industrial development of the United States. Sophomores in Chemistry and Engineering; two hours, second semester.

268. AMERICAN POLITICAL HISTORY. A review of American political and social conditions from the Colonial period to the present time, treating of early English progress toward union and independence, of the Federal Constitution and the growth of nationality, of the conflict with state sovereignty, of the evolution of the slavery struggle, and of reconstruction. *Required* of Juniors in Arts; two hours, first semester; *elective* for Juniors and Seniors in Arts; two hours, second semester.

269. UNITED STATES HISTORY. The study of special periods in United States history, by means of topical research and discussion, involving some mastery of the methods of investigation to be pursued in all such work. For this course there may be substituted, at the discretion of the instructor, a study of the development of the American city, with a discussion of problems of municipal function, control, and organization. *Elec-*

tive for Seniors in Arts; three hours, second semester.

270. POLITICAL HISTORY OF THE UNITED STATES FROM 1783 TO 1829. A course emphasizing the Critical Period, the origin, formation, and adoption of the Constitution, the organization and development of the Federal Government. Lectures, parallel reading, and special research assignments. *Elective* for Graduate Students; two hours, both semesters.

271. STUDIES IN NATIONAL GOVERNMENT. A course treating of the governments of the leading nations with especial attention to existing federations. Assigned topics, reports, and discussions. *Elective* for Graduate Students; two hours, both semesters.

272. HISTORY OF SPAIN. A study of the social and political development of the Spanish people with especial reference to the periods of expansion and decay. This investigation of Spain's rôle among the nations and contributions to the world involves consideration of her general culture and ideals. *Elective* for Graduate Students; two hours, both semesters.

273. MODERN GERMANY. A course dealing with the rise of Brandenburg-Prussia, the part played by the Germanic States in the Napoleonic Wars, the steps in the foundation of the German

Empire, and a study of contemporary conditions *Elective* for Graduate Students; two hours, both semesters.

274. GREEK AND ROMAN HISTORY. A course dealing in detail with special problems in Greek and Roman History, the latter subject being considered to the reign of Justinian. *Elective* for Graduate Students; two hours, both semesters.

275. HISTORY OF MOHAMMEDAN CONQUEST. A survey of the history of Western Asia from its conquest by Alexander the Great to the middle of the fifteenth century, and involving an examination of the doctrines and spread of Islam. Attention is also paid to contemporary conditions in Europe. *Elective* for Graduate Students; two hours, both semesters.

XI. ITALIAN

PROFESSOR COLLINS.

290. ELEMENTARY ITALIAN. A course involving the study of the outlines of Italian grammar, with the preparation of written exercises, and the translation of easy texts and selections from the classics, supplemented by conversational drill. *Elective* for Seniors in Arts; three hours, both semesters.

291. DANTE. A critical study of Dante's *Divina Commedia* with reference to its literary

worth and its interpretation as a religious and political document. Other works of Dante are also considered. *Elective* for Seniors in Arts and Graduate Students; two hours, both semesters.

XII. LATIN *

PROFESSOR WARNER.

300. CICERO. A course comprising readings from Cicero's *De Senectute* and *De Amicitia*, accompanied by drill in the grammar, and a study of Roman history peculiar to the course. Freshmen in Arts electing Latin; and *elective* for other Arts students; three hours, first semester.

301. LIVY. A study of Books XXI and XXII, with sight readings from other parts of the author's work. Roman history applicable to the reading work. Composition. Freshmen in Arts electing Latin; and *elective* for other Arts Students; three hours, second semester.

302. TACITUS AND PLINY. The *Agricola* and *Germania* of Tacitus are read rather for the purpose of acquaintance with the work than for the technique of style. Selections from Pliny. Sophomores in Arts, electing Latin; and *elective* for other Arts Students; three hours, first semester.

* Provision for those who desire to begin the study of Latin is made by arrangement with the Polytechnic Preparatory School; but such elementary courses are optional and may not be counted toward a degree.

303. HORACE. Selections from the Odes and Epistles are read. The course includes also studies in Roman archæology, architecture, and in Roman life. In addition to the Horace there are read at sight selections from the letters of Cicero with a view to the consideration of Latin epistolary style. Sophomores in Arts electing Latin; and *elective* for other Arts Students; three hours, second semester.

304. PLAUTUS AND TERENCE. Through the stated reading of particular plays and sight reading from others, the student becomes familiar with the spirit of Roman comedy. The development of Roman comedy and the history of Roman literature is followed by means of lectures and special studies. *Elective* for Juniors and Seniors in Arts; two hours, both semesters.

305. ROMAN SATIRE. Readings from the Satirists illustrating the development of Roman Satire and the spirit of the time. *Elective* for Graduate Students; two hours, both semesters.

306. CATULLUS AND THE ELEGIAC POETS. A course involving the reading of the poems of Catullus, Tibullus, Propertius, and Ovid, together with a consideration of the social and public life of the time. *Elective* for Graduate Students; two hours, both semesters.

XIII. MATHEMATICS

PROFESSOR CHITTENDEN, MR. CHILD, AND MR. HEGEMAN.

320. SOLID GEOMETRY. A review of the principles of Euclidian Geometry of three dimensions; practice in the solution of original problems. Freshmen in Arts, and Freshmen in Engineering who are conditioned in this subject; two hours, first semester.

321. PLANE TRIGONOMETRY. Theory of the trigonometric and circular functions; solution of triangles by natural functions, and with the aid of logarithms; analytical transformations, and applications to practical problems. All Freshmen; three hours, first semester.

322. HIGHER ALGEBRA. A review of quadratic equations, ratio and proportion, variation and progressions; study of the binomial theorem, for all exponents; the theory of logarithms; limiting values; series, especially logarithmic and exponential, and primary conditions for convergency; undetermined coefficients; theory of determinants and its application to the solution of linear equations. All Freshmen; two hours, first semester.

323. THEORY OF EQUATIONS. A course based on Burnside and Panton; review of the elementary properties of equations; the roots of unity, solution of the cubic and biquadratic; symmetric

functions of roots; Sturm's Theorem; Horner's method for the solution of numerical equations, and Cardan's solution of the cubic. Freshmen in Chemistry and Engineering; two hours, second semester; *optional* for Freshmen in Arts.

324. ANALYTICAL GEOMETRY. Development of Cartesian and polar co-ordinate systems; equations of loci and plotting of the corresponding curves; special study of harmonic curves; the straight line; the circle; transforming of co-ordinates; the conic sections as a class; tangents, normals and polars, properties of the parabola, ellipse, and hyperbola; interpretation of equations in three dimensions and in particular the straight line, the plane and the central quadric surfaces. Freshmen in Engineering and Chemistry; five hours, second semester.

325. DIFFERENTIAL CALCULUS. A course based on Murray's Infinitesimal Calculus conducted to serve the requirements of Engineers. The derivative is viewed from the standpoint of the theory of limits and practice is afforded in the identification of it with a variable rate and the slope of a plane curve. The theory of infinitesimals is then discussed, and the fundamental theorems of Leibnitz are developed, the derivative appearing as the ratio of two infinitesimals of the same order. Numerous exercises are given in determining lengths of tangents, nor-

mals, maxima and minima, and in plotting plane curves after the determination of primary singular points. Continuity and primary number concepts are reviewed. The principal formulas for differentials are developed and emphasis is laid upon their practical applications. Sophomores in Engineering; three hours, first semester.

326. INTEGRAL CALCULUS. A continuation of the Course in Differential Calculus. The integral is considered as the inverse of the differential in several special cases, and the definite integral is developed as the limit of the sum of an infinite series of infinitesimals based on the second principle of Leibnitz and graphically illustrated as a plane area. The primary formulas are considered. The theory of definite integrals is investigated and their applications are treated, including areas, lengths of plane curves, moments of inertia, volumes, and surfaces. Finally, the theorem of Mean Value is considered in different forms, and applied to the development of functions in series. Sophomores in Engineering; three hours, second semester.

327. DESCRIPTIVE GEOMETRY. The student is required to read Church's Descriptive Geometry, supplementing it by the preparation in the drawing room of plates, covering the following problems: point, line and plane, single-curved surfaces, double-curved surfaces, and warped sur-

faces ; intersections, tangencies, and developments. The student is advised at the same time to elect the course in perspective in the Department of Art. Sophomores in Engineering ; three hours, second semester.

328. ANALYTICAL MECHANICS. The object of this course is to emphasize the principles fundamental in every branch of applied mechanics and to familiarize the student with the mathematical difficulties to be met in the works devoted to this science. In the first semester are treated the primary principles of analytical statics, including a study of the composition and resolution of forces, application to rigid bodies, centres of gravity, centres of mass, friction, virtual work, flexible strings, the funicular polygon, the catenary and loaded chords, and the theory of attraction ; involving a large number of mathematical examples chosen to illustrate special, as well as general methods. In the second semester, the analytical theory of kinetics is developed, and in particular are treated laws of motion, variable forces, constrained motion, resisting medium, central forces, impact, energy, work, dynamics of the steam engine, moments of inertia, rotary motion, the simple and compound pendulum, and the equations of Lagrange, Hamilton, and Euler. Juniors in Engineering ; five hours, first semester ; two hours, second semester.

329. DIFFERENTIAL EQUATIONS. A course designed to familiarize the student with the elements of differential equations to the extent demanded in ordinary works on mechanics. The use of the "Key to the Solution of Differential Equations" in Byerly's Calculus is taught, and the theory on which it is based is systematically developed. The derivation of differential equations, classification, an interpretation geometrically and physically are also involved. Seniors in Civil and Electrical Engineering, and *elective* for Juniors in Engineering; two hours, first semester.

330. PROBABILITY AND METHOD OF LEAST SQUARES. A brief course involving a review of the theory of probability, a study of the probability curve, and of mean and probable errors, with a consideration of the criteria for determining the measure of precision, weight, and adjustment of observations. Optional for Seniors in Civil Engineering; two hours, second semester.

331. ADVANCED DESCRIPTIVE GEOMETRY. A course involving a study of the polyhedral angle and the projections of the sphere. *Elective* for Juniors, Seniors, and Graduate Students. Two hours, first semester.

332. ADVANCED CALCULUS. A more extended study of the complex variable, the theory of limits, the theory of infinitesimals, and of the definite

integral. *Elective* for Juniors, Seniors, and Graduate Students; two hours, both semesters.

333. ADVANCED DIFFERENTIAL EQUATIONS. A more extended course than that in Differential Equations, involving a study of forms of the second and higher orders, together with a careful consideration of their geometrical significance. *Elective* for Seniors and Graduate Students; two hours, second semester.

334. FOURIER'S SERIES; HARMONIC FUNCTIONS. A course designed to meet the requirements of advanced students who are interested in mathematical physics, and especially recommended to students of Electrical Engineering. Certain important differential equations, in particular those of Laplace and Lagrange, which occur in the theory of the potential, vibrating strings, flow of heat and electricity are studied and their particular solutions in special cases are developed in Fourier's Series, Bessel's functions, focal and spherical harmonics. *Elective* for Seniors and Graduate Students; one hour, both semesters.

335. CALCULUS OF FINITE DIFFERENCES. A course based on Boole's Calculus of Finite Differences, with a view to the application of the theory to the problem of life insurance. Actuaries and students interested in actuarial problems are requested to confer with the instructor as to their

needs in this subject. *Elective* for Seniors and Graduate Students; one hour, both semesters.

336. VECTOR ANALYSIS AND QUATERNIONS. A course dealing with scalars, vectors, versors and tensors as elements and as operators. The nature of the quaternion operator is considered and applications to geometry, trigonometry, and mechanics are made. *Elective* for Juniors, Seniors, and Graduate Students; one hour, both semesters.

337. THEORY OF FUNCTIONS. Theory of functions of a complex variable presenting the elements of the work of Cauchy, Weierstrass, and Riemann, in connection with such subjects as infinite series, integration, conformal representation, and a few lectures on the elliptic functions. Graduate Students; one hour, both semesters.

338. THEORY OF INVARIANTS. Invariants and co-variants of binary forms are developed in connection with the general linear transformation, considerable attention being given to the symbolic methods. The geometry of the point groups involved is emphasized. Graduate Students; one hour, both semesters.

XIV. MECHANICAL ENGINEERING

PROFESSOR ENNIS, PROFESSOR TAGGART, MR. PERRY, AND
MR. ADAMS.

360. MACHINE DRAWING. A thorough course in drafting, including dimension sketching from machines, copying detail drawing to scale, making tracings and blue prints. Sophomores in Chemical, Mechanical, and Electrical Engineering ; five hours, first semester.

361. PRINCIPLES OF MECHANISM. An introduction to simple mechanisms, including the forms of screws, cams, gear wheels, links, escapements, and quick return devices, followed by a study of their motions and combinations in various constructions. Sophomores in Mechanical and Electrical Engineering ; five hours, second semester.

362. ENGINEERING DRAWING. A course in the graphic solution of problems in the design of single pieces of mechanism involving but one force, as tension or compression. Juniors in Mechanical Engineering ; three hours, first semester.

363. ELEMENTARY MACHINE DESIGN. A text-book course of problems in the calculation of stresses in various parts of machines and the design of shafting, pulleys, hangers, gears, fly-wheels, wire rope, conveying machinery and transmission systems followed by their application to the design of the assembled machine and

a drawing of the same. The construction details are carefully considered and the calculations are made according to theoretical principles, the use of hand books and empirical formulæ not being permitted in this course. As instances of problems in Machine Design in process of solution by the present junior class may be cited the following: dog for lifting five-ton foundry ingots, step bearing for 12,000 lbs. hydraulic jib crane, traveling staircase, epicyclic gear train for a differential dynamometer, thrust bearing with bed plate suitable for a given engine, two-ton hoisting crab with a safety brake, differential brake, ten-ton foundry crane, telescopic screw jack with lift of 15 feet not to be longer than 8 feet, friction clutch of 100 tons, gear train of a traveling crane 40 feet span, punching press with automatic return, twenty-ton testing machine, chain transmission of power, belt shifter and reverser and quick return for a planer. Juniors in Mechanical, Chemical, and Electrical Engineering; five hours, second semester.

364. ADVANCED MACHINE DESIGN. This is a series of exercises in the calculation of the stresses in frames and structures, assigned for individual design. Sketches, strain sheets, shop drawings, assembled drawings, and bills of material are prepared with the aid of hand books and theoretical and empirical formulæ. Travel-

ing cranes, triplex hand hoists, shaft governors, and Corliss valve systems are some of the examples already executed by members of the class. Seniors in Mechanical Engineering; eight hours, first semester, and five hours, second semester.

365. THERMODYNAMICS. A study of the properties of gas and vapors, the conversion of heat into work, the compression of air and the theory of refrigeration. Juniors in Engineering; two hours, first semester.

366. HEAT AND OTHER MOTORS. An analytic study of the structural details of various types of steam engines, examined from a mechanical point of view, followed by a course dealing with the dynamics of steam, gas, oil, and hot air engines, the methods of reducing cylinder condensation by compounding, jackets and superheating, testing engines, interpreting indicator diagrams, setting valves, and the influence of reciprocating parts. Juniors in Civil, Electrical, and Mechanical Engineering; three hours, both semesters; Juniors in Chemical Engineering; first semester only.

367. MECHANICAL LABORATORY. A series of tests and calibrations of the various appliances to be used in the subsequent laboratory work, including the accuracy of graduation of thermometers, gauges, and indicator springs, the value of lubricants, the calorific value of coals, the quality

of steam, and tests of the efficiency of belts, governors, electric motors, oil and steam engines under varied loads. At least three twelve-hour tests are made of the laboratory engines and boilers, and several protracted tests are made of outside power plants, such as a tugboat, an ice-making plant, a trolley power station, etc. Juniors in Civil, Electrical, and Mechanical Engineering; three hours, first semester.

368. BOILERS AND INJECTORS. A discussion of the various types of boilers, their mountings, grate area, safety attachments, the economic combustion of solids, liquid and gaseous fuels, mechanical stokers, prevention of corrosion, purifiers, feedwater heaters, natural and forced draft, and the relative merits of injectors, with examples in boiler design. Juniors in Mechanical Engineering; two hours, second semester.

369. CHIMNEY CONSTRUCTION AND DESIGN. A discussion of the principles of stability as applied to the construction of chimneys in brick, concrete, and steel. One problem is assigned to each student for solution and one or more chimneys are inspected. Seniors in Mechanical Engineering; one hour, first semester.

370. POWER GENERATION. A study in the design and economic operation of power plants involving the location of the plant, coal handling, water purification, proportioning boilers, selection

of engines, steam turbines, foundations and specifications, piping systems, condensers, cooling towers, economizers, air compressors and air transmission. Seniors in Mechanical Engineering; three hours, second semester.

371. HEATING AND VENTILATION. An examination of the requirements for the proper sanitation of large private and public buildings, considering heat losses, sizes of radiators, boilers for steam, hot air and hot water systems, ventilating ducts, and fans. A twenty-four hour test is made of the College heating plant, and tests are yearly conducted of one or more outside heating systems. Seniors in Mechanical Engineering; two hours, first semester.

372. HYDRAULICS. A thorough course in elementary hydraulics dealing with the static and dynamic properties of water. The course includes hydrostatics, flow of water through orifices, tubes and nozzles, flow in pipes and open channels, flow over weirs, measurement of flow, and the apparatus used for measuring the flow. It shows the losses that take place and how these are allowed for by experimental co-efficients, and at the same time shows clearly the limits within which the formulæ can be used. The course is supplemented by the work in the Hydraulic Laboratory. Juniors in Engineering; three hours, second semester.

373. PUMPS AND PUMPING. A course in the constructive details of typical pumps and their design, supplemented by laboratory work and outside tests. Seniors in Mechanical Engineering; two hours, second semester.

374. HYDRAULIC LABORATORY. A series of tests of efficiency of water wheels and water motors, pumps, etc.; practice in the calibration of weirs, jets and orifices. Juniors in Civil, Electrical, and Mechanical Engineering; three hours, second semester.

375. HYDRAULIC LABORATORY. A laboratory course involving the dissection of pumps, the sketching of their construction, and the testing of their efficiency under various conditions. Large pump manufactories, as well as the engines of the City Water Department are inspected for supplementary study. Seniors in Chemical and Mechanical Engineering; three hours, first semester.

376. MILL DESIGN AND ADMINISTRATION. A study in the designing of slow-burning and fire-proof structures for mills and factories, with examples of the relative costs of various parts of buildings, sprinklers, and of types of fire protection. This is followed by an examination of the organization of the shop staff and methods of determining the cost of production, card systems of accounting material, and distribution of indirect

expenses. Seniors in Mechanical Engineering; two hours, second semester.

377. PRIME MOTORS. A study of the structural details of Corliss and marine engines, automobiles, their valve design and governors, and of locomotives, air brakes, and train resistance. An annual locomotive test is made when the arrangements can be effected. Seniors in Mechanical Engineering; three hours, first semester.

378. CARPENTRY. A course in carpentry, including the use of band saw and circular saw, wood turning, pattern making, and foundry work. Freshmen in Civil and Electrical Engineering; three hours, both semesters. Freshmen in Mechanical Engineering; six hours, both semesters.

379. FORGING. A course in forging iron, including bending, shaping, and welding, followed by forging and tempering tools from tool-steel. In this course forgings and tools are made for use in the machine shop. Sophomores in Mechanical Engineering; six hours, first semester. Sophomores in Civil and Electrical Engineering; three hours, first semester.

380. CHIPPING AND FILING. Chipping cast and wrought iron, filing true surfaces, free-hand filing, fit filing, and scraping. Sophomores in Mechanical Engineering; six hours, second sem-

ester; Sophomores in Civil and Electrical Engineering; three hours, second semester.

381. MACHINE WORK. The student is first given practice in the use of each type of machine in the shop, and is then required to finish castings and forgings from blue print working drawings after the most approved methods in use. Special attention is paid to accuracy of fit and nicety of finish. The course culminates in the making, tempering, and grinding of arbors, milling cutters, and other tools. Advantage is taken of the proximity of large and reputable machine shops to witness special operations. Juniors in Mechanical Engineering; six hours, both semesters. Juniors in Electrical Engineering; three hours, both semesters.

382. MECHANICAL EQUIPMENT OF TALL BUILDINGS. A course considering the tall building and its special requirements, such as elevator service, heating and ventilation, sanitation, water systems, lighting and electric services, and power plant. Seniors and Graduate Students in Mechanical Engineering; twelve hours.

383. HEATING AND VENTILATING. A course discussing the problems of heating and ventilating churches, schools, hospitals, and department stores, and involving a study of steam and hot water systems, independent power plants, chimneys, boilers, and automatic control. Seniors and

Graduate Students in Mechanical Engineering; sixteen hours.

384. AERODYNAMICS. A brief course concerned with the fan blower, its uses, and the practical applications to mechanical draft. Seniors and Graduate Students in Mechanical Engineering; four hours.

385. REFRIGERATION AND COLD STORAGE. A course concerned with mechanical methods of refrigeration. The history and theory of such refrigeration are presented and various systems such as ammonia, wet and dry compression, and absorption machines and their tests are discussed. Seniors and Graduate Students in Mechanical Engineering; twelve hours.

386. COMMERCIAL FUELS. A brief course dealing with the mechanical preparation of anthracite and bituminous coals. Seniors and Graduate Students in Mechanical Engineering; four hours.

387. THESIS FOR THE DEGREE OF MECHANICAL ENGINEER. An original investigation of some phenomenon, a test of a formula, an engineering report upon some method or structure, or the design and erection of some piece of machinery in the preparation of which the student must evolve his own methods and build such apparatus as is necessary for the prosecution of his work. Some of the subjects thus far assigned are:

the flow of steam through orifices, the design and construction of a steam hammer for use in the shops, an outward-flow steam turbine, a ten horse-power air compressor, an eight horse-power duplex two-cycle marine oil engine, and the proper setting of locomotive valves. Seniors in Mechanical Engineering; five hours, first semester; fifteen hours, second semester.

388. LOCOMOTIVE ENGINEERING AND DESIGN. This course, though modified to the necessities of the individual, has special reference to the problems of the motive power department of railway service. It includes the designing, processes of manufacture, and repairing of locomotives; tests of their capacity, and analysis of the conditions of the operating department; cost of train driving, grades, tunnels, signals, signalling; wage systems; discipline, organization; terminals; estimating value of improvements; elements determining choice of route, and the balanced compounds vs. electrification. *Elective* for Graduate Students; three hours, both semesters.

389. PROPELLING MACHINERY. A course dealing with the kinematics of propulsion, consisting of an analytic discussion of the resistances of ships; making progressive speed trials; buoyancy and stability; fairing the lines of a vessel; methods of designing screw propellers and paddles; description of types of marine engines; prob-

lems of balancing and the elimination of vibration; consideration of the steam turbine, and auxiliary motor machinery. *Elective* for Graduate Students; five hours per week, both semesters.

XV. NATURAL HISTORY

PROFESSOR OLSEN AND MR. PETERS.

400. ZOÖLOGY. A study of the animal kingdom, including descriptions of the first five subkingdoms with their divisions into classes, and of the sixth sub-kingdom as far as the description of the orders. This course also involves special studies of those orders in which collections may easily be made. *Elective* for Sophomores, Juniors, and Seniors in Arts; two hours, first semester.

401. GEOLOGY. A study of geology with especial emphasis upon paleontology as the only means of identifying the various groups of rocks, and a survey of lithology so far as to identify in practice the rock formations in the vicinity of New York. Sophomores in Arts and Civil Engineering; two hours, second semester.

402. GENERAL BOTANY. A course of lectures, recitations, and laboratory work, involving the study of the lowest forms of vegetable life, unicellular and filamentous algæ, seaweeds, slime-

moulds, rusts, smuts, and various other fungi. Some attention is also paid to mosses, liverworts, ferns, and flowering plants. *Elective* for Juniors and Senior in Arts ; two hours, first semester.

403. INDUSTRIAL OR ECONOMIC BOTANY. A course of lectures, recitations, and laboratory work, involving the identification of trees from the general appearance of growth, bark and buds ; strength, structure, disease, and specific uses of the various timbers ; and the fundamental principles of timber physics. Attention is given to sand-binding plants and to microscopic plants affecting city water supply. *Elective* for Juniors and Seniors in Arts, and *optional* for Juniors and Seniors in Chemistry and Engineering ; three hours, second semester.

404. DESCRIPTIVE MINERALOGY. A study of crystallography and the application of the knowledge of the crystal systems so derived in determining given minerals. Models of glass and wood are used to illustrate the lectures. Juniors in Chemistry ; four hours, first semester.

405. DETERMINATIVE MINERALOGY. A practical study of minerals by blow-pipe analysis and other methods. Juniors in Chemistry ; four hours, second semester.

XVI. * PHILOSOPHY

PROFESSOR MONTAGUE AND MR. HARTMANN.

410. LOGIC. A study of the formation and uses of concepts and judgments in the syllogism, together with a discussion of fallacies and practical exercises in deductive and inductive logic. Juniors in Arts; two hours, second semester; *required* of Students of the Course in Pedagogy; thirty hours.

411. PSYCHOLOGY. General outlines of psychology beginning with a study of psychological processes, and proceeding to a consideration of the laws of mind itself in the psychology of sensation, of knowledge, of feeling, and of will. Juniors in Arts; three hours, first semester; *required* of students of the Course in Pedagogy; forty-five hours.

412. EDUCATIONAL PSYCHOLOGY. A course involving the study of mental development in the child and the race, and presenting an application of the principles of psychology to efficient teaching. *Elective* for Juniors and Seniors in Arts; two hours, first semester; *required* of students of the Course in Pedagogy; thirty hours.

413. ETHICS. A study of the types of ethical

* For other courses in Philosophy, see Education, p. 143.

theory in the order of their historical unfolding, and of the fundamental problems of human conduct, the rights and duties of man. Seniors in Arts; three hours, second semester; *elective* for Students of the Course in Pedagogy; forty-five hours.

414. *ÆSTHETICS*. A survey of the historical development of the philosophy of the beautiful in art and nature. *Elective* for Seniors in Arts and Graduate Students; two hours, second semester.

415. *ANCIENT AND MEDIAEVAL PHILOSOPHY*. A course presenting the development of philosophical thought from the first Greek Cosmogonies to the Renaissance, with especial emphasis upon the contributions of Plato and Aristotle. Phases of Hellenic-Roman thought, including Stoicism, Epicureanism, Neo-Platonism, Gnosticism, and early Christianity will also be discussed. *Required* of Seniors in Arts; three hours, first semester.

416. *MODERN PHILOSOPHY*. A course dealing with the development of modern philosophical thought, considering in detail the progress of Continental rationalism from Descartes and of English Empiricism from Bacon and Hobbes, and discussing the critical method of Kant and the contributions of his successors. *Elective* for Seniors in Arts; three hours, second semester.

417. PHILOSOPHICAL TYPES. A consideration of Plato, St. Anselm, Descartes, Berkeley, and Hume as types of philosophical imagination and temperament. The course involves the reading in their entirety of one or more classical texts to represent each writer. *Elective* for Graduate Students; two hours, both semesters.

418. BRITISH PHILOSOPHY. An historical study of the development of British philosophy through an examination of its representative works. *Elective* for Graduate Students; two hours, both semesters.

419. READINGS IN THE LITERATURE OF ETHICS. A course illustrating through the reading and discussion of representative texts three great ethical attitudes; the common-sense ten-commandment ideal; utilitarianism, and the ideal of self-realization. *Elective* for Graduate Students; two hours, both semesters.

420. KANT AND HIS SUCCESSORS. A detailed course investigating the critical philosophy of Kant in its relation to preceding thought, and considering its development in the systems that followed, with especial attention to Hegel. *Elective* for Graduate Students; two hours, both semesters.

421. STUDIES IN CONTEMPORARY PHILOSOPHY. An investigation of philosophical developments and tendencies of the present through a

systematic course in the critical reading of recent works, supplemented by lectures and discussions. *Elective* for Graduate Students; two hours, both semesters.

XVII. PHYSICS

PROFESSOR SHELDON, MR. ASHE, AND MR. KOUWENHOVEN.

430. MECHANICS AND HEAT. A thorough course in the fundamental principles of mechanics and heat; force, work, energy, and power being brought to the attention of the student and differentiated from one another by means of many problems. Freshmen in Engineering and Chemistry, and *optional* for Sophomores in Arts; two hours, both semesters.

431. ELECTRICITY AND MAGNETISM. An introduction to the elementary principles of electricity and magnetism with a short description of some of their applications to commercial and industrial problems. Sophomores in Engineering and Chemistry, Juniors in Arts; three hours, first semester.

432. SOUND AND LIGHT. A detailed study of the principles and phenomena of sound and light. Sophomores in Engineering and Chemistry, Juniors in Arts; three hours, second semester.

433. LABORATORY PHYSICS. A course involving the quantitative measurements of some of the

more common physical constants, conducted with particular view to supplementing Courses 430, 431, and 432. Sophomores in Engineering and Chemistry; and *elective* for Juniors and Seniors in Arts; two hours, both semesters.

434. ELECTRICAL MEASUREMENTS. A course demanding the precise determination of the common electrical and magnetic magnitudes, and involving the use of many valuable standards possessed by the laboratory and put directly in the hands of the student. The work of those intending to enter upon telephone engineering will be arranged with that end in view. Sophomores in Electrical Engineering; six hours, second semester.

435. PHYSICAL THEORY. A study of the theory of electrons as based upon the experimental results of recent researches concerning ionization, radioactivity, and the conduction of electricity through gases. *Elective* for Graduate Students; three hours, second semester.

XVIII. POLITICAL AND SOCIAL SCIENCE

PROFESSOR GREEN.

450. POLITICAL ECONOMY. The elements of economics derived from an analysis of modern industrial society, and involving a study of the nature and scope of economic science, fundamental economic concepts, the organization of in-

dustry, the theory of value, the distribution of wealth, and the functions of government. All Juniors; two hours, first semester.

451. FINANCE. A study of the principles of public finance with a consideration of the budget, national and local taxation, public debts, and state banks, as aids to public credit. *Elective* for Juniors and Seniors in Arts; three hours, second semester.

452. SOCIOLOGY. An outline study of social evolution in its principal stages, involving the analysis of past and present societies, of projected ideal societies beginning with Plato's Republic, and a determination of the requisites of social survival, social efficiency, and social control. *Elective* for Juniors and Seniors in Arts; three hours, second semester; *elective* for Students of the Course in Pedagogy; forty-five hours.

453. COMPARATIVE CONSTITUTIONAL LAW. A survey of the formation and evolution of American political institutions, with particular attention to the United States Constitution both as to text and the causes leading to its adoption. together with a comparative study of the governments of the leading European nations. *Elective* for Seniors in Arts; three hours, first semester.

454. INTERNATIONAL LAW. A study of the origin and development of those rules which are

recognized as binding in the inter-relations of civilized states, and a consideration of present problems and important treaties of the past with especial attention to American diplomacy. *Elective* for Seniors in Arts; three hours, second semester.

455. ECONOMIC THEORY. A course treating of the evolution of economic theory as seen in the works of Smith, Mill, and Ricardo, with especial attention to the claims of the socialist school as represented by Saint-Simon, Owen, and Marx. *Elective* for Graduate Students; two hours, both semesters.

456. INDUSTRIAL DEVELOPMENT. A study of the evolution of industry from Greek and Roman days to the present. The earlier portion of the course will be given to the consideration of industrial progress through family economy, the guild system, and the beginnings of organized manufacture, in order that a foundation may be laid for the consideration of trusts, labor organizations, and the relations of the state to industry. *Elective* for Graduate Students; two hours, both semesters.

XIX. SPANISH

PROFESSOR COLLINS.

470. ELEMENTARY SPANISH. A course involving a study of the outlines of Spanish gram-

mar, practice in writing Spanish, the translation of narrative and descriptive prose, together with considerable conversational drill. *Optional* for Sophomores, Juniors, and Seniors in Chemistry and Engineering, and *elective* for Juniors and Seniors in Arts; three hours, both semesters.

471. SPANISH LITERATURE. A course involving a survey of Spanish syntax preparatory to a study of the outlines of the history of the language and literature from a Spanish text-book, and the translation of, and commentary upon, classical and modern works, together with a reproduction in the student's own words of the texts read. *Elective* for Seniors in Arts; three hours, both semesters.

472. OLD SPANISH. A study of comparative grammar with reference to Old Spanish, involving the translation of selected texts. *Elective* for Graduate Students; two hours, both semesters.

473. THE CID. The story of the Cid as variously treated from the earliest times to the present day, involving a consideration of its influence on foreign literatures. *Elective* for Graduate Students; two hours, both semesters.

474. SPANISH DRAMA. A course dealing with the evolution of the Spanish drama, its tendencies, traits, and the influences it has felt, with especial stress upon the plays of the Golden Age.

Elective for Graduate Students; two hours, both semesters.

475. THE NOVELA. A study of the development of the Spanish *Novela* from its origins to the present day. *Elective* for Graduate Students; two hours, both semesters.

Evening Courses in Chemistry and Engineering

For Courses in Mathematics, many of which are to be taken in conjunction with these subjects of instruction, consult the list offered under the caption "Courses for Teachers" at p. 225. Courses which are subnumbered in brackets have already been described under these numbers, pp. 123 to 201, inclusive; but as they are given in the afternoon or evening they are repeated here for convenience. Courses not so subnumbered differ, as a rule, in scope or hours from the regular courses of day instruction.

SUBJECTS OF INSTRUCTION

CHEMISTRY

600. PREPARATION OF THE TYPICAL COMPOUNDS OF CARBON. A course involving the preparation of the various derivatives of the hydrocarbons, halogen compounds, acid derivatives, ethers, and ammonia derivatives. The reactions of the compounds made are studied in the laboratory. This course furnishes the basis for the further study of organic chemistry in its various subdivisions. Ten lectures and twenty-five evenings of laboratory work, sixty hours.

601. CHEMISTRY OF THE COAL-TAR DYES. A systematic study of the relations which the coal-tar dyes bear to the refined products of coal-tar involving the preparation in the laboratory of

typical dye-stuffs and a study of their properties. The discussion of these dyes affords a foundation for more extended acquaintance with the methods of foundation of the great classes of modern aniline dyes. Some knowledge of organic chemistry is desirable on the part of students intending to take this course. Ten lectures and twenty-five evenings of laboratory work ; sixty hours.

602. QUANTITATIVE CHEMICAL ANALYSIS. Lectures upon the analysis of brass, bronze, German silver, solder, type, babbitt and britannia metals, and the fusible alloys. Methods, mainly gravimetric, for the determination of all the heavy metals are given and the analysis of several of these metals is carried out by the students in the laboratory. While this course is designed for those who have already had some experience in quantitative analysis, it may be taken by students who have had only qualitative analysis. Ten lectures and twenty-five evenings of laboratory work ; sixty hours.

603. ANALYSIS OF FATS, OILS, SOAP, AND GLYCERINE. The analysis of edible and lubricating oils, butter, and oleomargarine as well as of all grades of commercial fats, soap, and glycerine is considered, and methods of analysis, chiefly volumetric, are fully discussed. The analysis of several of the substances is carried out by the students in the laboratory. This course is designed

for students who have already had experience in quantitative analysis. Ten lectures and twenty-five evenings in laboratory work; sixty hours.

604. WATER ANALYSIS. A course devoted to the determination of those constituents of water which affect its sanitary condition. Instruction is given in a special water laboratory thoroughly equipped for this work alone. Twelve laboratory periods devoted to the analysis of drinking water. Twenty-four hours.

605 [60]. SANITARY AND INDUSTRIAL WATER SUPPLY. A course considering the chemistry, biology, filtration and purifying of water, the relation between water supplies and the public health, and various methods of sewage disposal. Seniors and Graduate Students in Chemistry; twelve hours.

607 [62]. FOODS AND THEIR ADULTERATION. A course dealing with the relation of Chemistry to foods and beverages and to health, and involving a consideration of metabolic processes, digestion, assimilation, excretion, composition, and adulteration. Seniors and Graduate Students in Chemistry; twelve hours.

608 [63]. GENERAL TECHNICAL CHEMISTRY. A course dealing with such subjects as fuels, wines, tartar-products, leavening agents, and in-

dustrial wastes and their utilization. Seniors and Graduate Students in Chemistry; ten hours.

CIVIL ENGINEERING

609. HYDRAULICS. A course of fifteen lectures in Hydraulics, supplemented by ten exercises in the Hydraulic Laboratory.

This is a thorough course in elementary hydraulics, dealing with the static and dynamic properties of water. The course includes hydrostatics; a study of the pressure exerted by water in pipes, on dams, boats and submerged surfaces: and theoretical hydraulics; a study of the flow of water in pipes, canals and rivers, flow over weirs, and the discharge through orifices, tubes and nozzles. The various methods of measuring flow by weirs, nozzles, orifices and current meters are discussed and applications shown by various examples, solution of which is required by the members of the class. The various losses due to friction, etc., and the methods of allowing for these losses are clearly shown.

In the laboratory, tests are made to illustrate the lecture work. The tests are the determination of the co-efficients for weirs, nozzles and orifices, and the friction loss in pipes and canals. Tests are also made on a water ejector and several forms of water motors. Thirty hours.

610. ELEMENTARY STRUCTURES. A course dealing with the computation of reactions, moments, and shears in simple beams and girders, with special reference to the effects of concentrated load systems. The design of simple beams is also considered. The course is supplemented by many problems, which are carefully corrected and returned. Thirty hours.

611. BRIDGE DESIGN. This is essentially a drawing room course, and includes the preparation of complete detail drawings of a plate girder bridge, and of a truss. The student first prepares the stress sheets from assigned data, and from these works out the drawing in detail in accordance with the practice of the best bridge companies. Each student is assigned a different problem, and the work is carefully checked at all stages by the instructor in charge. One hundred and fifty hours.

612. RAILROAD SURVEY AND DRAWING. A complete survey of a proposed railroad line not less than one mile in length. A location is chosen in rolling land within easy reach of the city, and a reconnaissance of the region between the terminals is made for the purpose of pointing out to the student the governing elements in the problem. This is followed by a preliminary survey, and from the data thereby obtained the location is decided upon and the final line staked out, a

map is drawn and an estimate made of the cut and fill. One hundred and twenty hours.

613. SURVEYING AND PLOTTING. This is a lecture course, upon the construction, adjustment and use of the chain, tape, compass, level, transit, and other appliances employed in ordinary surveying, supplemented by one day's field or office work each week. The work in the field includes individual practice with these instruments under the personal supervision of the instructor, and the making by the class of pacing, compass, transit and topographical surveys. The office work consists of the making of a finished topographical map from notes obtained in the field, and of the solution of numerous problems arising in the work of a surveyor. One hundred and twenty hours.

ELECTRICAL ENGINEERING

617 [133]. ALTERNATING CURRENTS. A course of lectures and recitations on the theory of alternating currents. The characteristics of alternating current circuits are treated from the physical standpoint, making use of advanced mathematics only when absolutely necessary. The principles of operation and general utility of alternating current generators, transformers, induction and synchronous motors, converters, motor meters, and the methods of calculating both

distributed and localized inductances and capacities are discussed. The lectures are occasionally illustrated by experiments. Thirty hours.

618 [430]. MECHANICS AND HEAT. A course in the fundamental principles of mechanics and heat, based upon the treatment given in *The Elements of Physics* by Nichols and Franklin. Thirty hours.

619 [132]. DYNAMO LABORATORY. A course involving a series of tests on the construction, regulation, efficiency, and operation of direct current dynamos and motors, together with a consideration of the efficiency and distribution of light, and the candle power of arc and incandescent lamps. Forty hours.

620. [134]. ALTERNATING CURRENT TESTS. A course involving general tests on the operation and regulation of single-phase and poly-phase generators, transformers, induction and synchronous motors, meters and converters, and also a number of quantitative tests concerning the phase relation of currents, fluxes, and electromotive forces in non-induction circuits and those having inductance and capacitance. Forty hours.

622 [136]. ELECTRIC TRACTION. A course of lectures on load and cost factors, on car and train resistance, on track construction, on interurban roads and city tramways, on conduit and special

sectional roads, on the characteristics of railway motors, on schedules, on motor capacity and gear ratio, on braking, and on the economics of electric railroading. Sixteen hours.

623 [137]. ELECTRICAL POWER TRANSMISSION. A course of lectures treating of the economics of transmission problems, of investigations concerning waterflow and watershed, of high and low head hydraulic machinery, of electrical machinery adapted to long distance power transmission, of the proper location and construction of transmission lines, of high and low tension distribution, and of transmission from coal and gas fields. Sixteen hours.

MECHANICAL ENGINEERING

626. STEAM ENGINES, GAS ENGINES, AND STEAM TURBINES. A course considering the construction and operation of steam and gas engines and such economic features as the arrangement of power plant, the proper choice of engines, and methods of conveying coal and discharging ashes. Thirty hours.

627 [23]. ELEMENTARY MECHANICAL DRAWING. A course of instruction in the use of instruments, pencil and ink drawing, lettering, elementary orthographic projection, isometric drawing, shades and shadows, and perspective drawing. Thirty exercises.

628. MACHINE DRAWING. A course of instruction in the elementary principles of machine drawing, such as the representation of bolts, nuts, screws, springs, and sections. After completing the preliminary work, sketches are made from actual machines, and detail and assembly drawings are prepared from these sketches. Thirty exercises.

Courses for Teachers in Arts and Pedagogy

For general information regarding these courses, and such matters as fees, credits, examinations, and hours, consult pp. 67 to 82, inclusive. Courses which are subnumbered in brackets have already been described under these numbers, pp. 123 to 201, inclusive; but as they are given in the afternoon or evening they are repeated here for convenience. Courses not so subnumbered differ, as a rule, in scope or hours from the regular courses of day instruction.

SUBJECTS OF INSTRUCTION

ART

800. FREE-HAND DRAWING. A course involving the use of pencil, charcoal, crayon, pen and brush, with outline work from the flat, and the drawing of blocks, ornaments, and casts from the real object. Thirty hours.

801. ADVANCED FREE-HAND DRAWING. Charcoal and crayon drawing from developed forms of architectural ornament and from casts of the human figure. Thirty hours.

802. TEACHERS' COURSE IN DRAWING. A series of graded exercises in drawing, intended to assist teachers in the public schools. Lectures and practical demonstrations. Thirty hours.

803. WATER-COLOR. A course in painting in water-color, dealing with still-life and landscape. Thirty hours.

804. OIL PAINTING. A course in landscape and still-life painting in oils. Thirty hours.

EDUCATION

805 [100]. HISTORY OF EDUCATION. A study of the growth of educational ideals and institutions from the time of the Greeks, with a view to considering present educational problems in the light of their historic unfolding. This course will involve some examination of the great classics of educational literature, as well as an attempt to co-ordinate social and political forces with the development of the various ideals and schools. Thirty hours.

806 [101]. PRINCIPLES OF EDUCATION. An exposition of the principles underlying the art of teaching, historically derived and applied to contemporary problems. Some attention is devoted to the European national systems with a view to determining the contributions they may make to organized education in the United States. Thirty hours.

807 [102]. PHILOSOPHY OF EDUCATION. A study of the aims and function of education from the philosophical standpoint, considering applications to it of psychology, its ethical aspects, and its relation to evolution. Thirty hours.

808 [103]. EDUCATIONAL MASTERPIECES. A course involving the study of the classics of education as reflecting educational ideals in ancient and modern times. Lectures upon periods and topics not easily studied at first hand are supplemented by reports upon assigned readings, and discussions upon the practical bearing of the theories considered. Works by Plato, Aristotle, Xenophon, Quintilian, Plutarch, Milton, Rousseau, Spencer, and others are critically examined. Thirty hours.

809 [104]. SCHOOL ORGANIZATION AND ADMINISTRATION. A course dealing in detail with the problems of educational administration and supervision. It discusses the relations of the executive officer to the public, the school board, the teacher, and the pupil, considering such matters as the program of studies, grading, examinations, promotions, record-keeping, prizes, the social life of the school, play, the proper construction and care of buildings, the function of the teachers' meeting, and financial requirements. The inspection of a number of schools will form a part of this course. Thirty hours.

810 [105]. GENERAL METHODS OF TEACHING. A course dealing with the sources and philosophical basis of present educational practice, attention being centred upon general methods applicable in the teaching of all branches. Thirty hours.

811 [106]. CURRICULUM AND METHODS OF ELEMENTARY SCHOOL TEACHING. A course dealing with the program of study and methods of instruction adapted to the elementary grades, and involving both observation of class work and practice teaching. Thirty hours.

812 [107]. SPECIAL METHODS. A course provided by the departments of Greek, Latin, English, German, French, History, and Mathematics, dealing with approved methods of teaching these special branches in the secondary school. Thirty hours.

ENGLISH

813. RHETORIC AND COMPOSITION. A course of lectures, conferences, and theme writing, illustrative of the principles and practice of English composition. Especial attention is given to the development of the paragraph and the essentials of exposition, description, and narration. Thirty hours.

814. GROWTH OF THE ENGLISH LANGUAGE. This course will trace in outline the development of English, with especial reference to the sources of its vocabulary, the changes its words and grammar have undergone, and the agencies by which these have been effected. Thirty hours.

815. OUTLINE OF ENGLISH LITERATURE. A course presenting in outline a view of the histori-

cal development of English literature, accompanied by readings from most eminent masters and by class discussions. Some attention will be devoted to the social influences vitally affecting the literature at great periods. Thirty hours.

816. REPRESENTATIVE ENGLISH POETS. A critical review of the masterpieces of a group of poets representative of great periods, movements, types of literature, and types of personality. Chaucer, Shakespeare, Spenser, Milton, Pope, Wordsworth, Byron, and Tennyson are considered by means of lectures, readings, reports, and discussions. Thirty hours.

817. SHAKESPEARE. A course of study dealing with the thought and the style of Shakespeare, with his characters, and the dramatic fitness of his plays. A number of typical dramas are read, analyzed, and discussed. Thirty hours.

818. THE DEVELOPMENT OF THE ENGLISH DRAMA. A study of the origin and evolution of the drama as literature, comprising the reading of typical plays by representative dramatists, some consideration of the theatre and its effect upon playwriting, as well as the laws of the drama. Thirty hours.

819. ENGLISH LITERATURE IN THE EIGHTEENTH CENTURY. An interpretation of English letters during the Augustan period, with particular emphasis upon classicism, the rise of the essay

and the novel, and the dawn of romanticism. Attention is given to Pope, Addison, Swift, Defoe, Richardson, Fielding, Smollett, Sterne, Goldsmith, Dr. Johnson, Walpole, the ballad revival, Thomson, Collins, Gray, Ossian, Chatterton, Cowper, and Burns. The course is largely historical, estimating the century's movement in relation to contemporary Continental letters as well as to English literature of the nineteenth century. Thirty hours.

820. STUDIES IN NINETEENTH CENTURY POETRY. A review of poetical achievement from Burns to the death of Tennyson, dealing with individual poets and with significant tendencies of the epoch. This course is appreciative rather than historical, and involves the reading and discussion of typical works of Wordsworth, Coleridge, Byron, Shelley, Keats, Tennyson, Browning, Arnold, Rossetti, and Swinburne. Thirty hours.

821. ORATORY. A course in the theory and practice of elocution, considering successively voice culture, pronunciation, enunciation, and accent, voice quality, emphasis, and effective action through gesture and facial expression. Attention is paid to both forensic and dramatic oratory. Thirty hours.

FRENCH

822. ELEMENTARY FRENCH. A course intended to provide a reading knowledge of easy French, and comprising a study of the essentials of French grammar, together with constant conversational drill. Thirty hours.

823. INTERMEDIATE FRENCH. A course involving the reading of French prose texts of moderate difficulty, the completion of the grammar, practice in idioms, and conversational drill. Sixty hours.

824. ADVANCED FRENCH. The study of modern French masters of verse, drama, and fiction, together with practical exercises in French composition. Lectures and discussions are conducted, so far as possible, in French. Thirty hours.

825 [202]. CLASSICAL FRENCH. A study of seventeenth century French literature, with especial reference to the drama in the works of Corneille, Racine, Molière, and to prose in the works of Bossuet, Fénelon, and Pascal. Thirty hours.

826 [205]. CONVERSATIONAL FRENCH. Practical exercises in modern French, comprising conversation upon topics of daily life and current events, in connection with readings from French periodicals and dictation for sight translation and reproduction. Thirty hours.

GERMAN

827. **ELEMENTARY GERMAN.** A course embracing the study of the elements of German grammar; exercises in the translation of simple sentences from and into English; the reading and translation of German prose and poetry of moderate difficulty; together with conversational drill based on the exercises and texts. Thirty hours.

828 [220]. **SECOND YEAR GERMAN.** A course involving a rapid review of the fundamental principles of German grammar, some study of derivation, the mastery of the main facts of consonant mutation, and the translation of prose texts of moderate difficulty and of representative lyric poems, together with exercises in prose composition and conversational drill. Thirty hours.

829. **CLASSICAL AND MODERN GERMAN.** A study of the writers of the classical and modern periods, including some consideration of the development of German literature. This course requires the translation from English into German of connected prose, and the reproduction in the student's own words of the texts read, together with constant conversational drill. Thirty hours.

830 [223]. **OUTLINES OF GERMAN LITERATURE.** A study of the history of classical and modern German literature from German textbooks, supplemented by extensive reading, and

embracing the critical examination of Faust and other masterpieces, with lecture commentary in German, and the preparation of essays in German based upon class readings and individual research. Thirty hours.

831 [225]. CONVERSATIONAL GERMAN. Practical exercises in modern German, comprising conversation upon topics of daily life and current events, in connection with readings from journalistic German and dictation for sight translation and reproduction. Thirty hours.

GREEK

832. ELEMENTARY GREEK. A course in elementary Greek for mature students, designed to give the preparation necessary for reading the easier prose authors, like Xenophon. It includes a study of paradigms and vocabularies and the writing of simple exercises. Thirty hours.

833. HISTORY OF GREEK LITERATURE. A survey of the work of some of the principal Greek writers, considering what they produced, the form and spirit of their works, and their relation to the development of universal literature. The authors specially to be considered are Homer, Æschylus, Pindar, Herodotus, Thucydides, and Plato. The course is illustrated by rather full selections. Thirty hours.

HISTORY

834. **EARLY AMERICAN HISTORY.** A review of American political and social conditions during the Colonial and critical periods, treating of Colonial progress towards union and independence, of the weakness under the Articles of Confederation, and of the adoption of the Constitution. Thirty hours.

835. **UNITED STATES HISTORY.** A course treating of the constitutional, political, economic, social, and industrial development of the United States since 1789, specially designed to meet the needs of teachers. Lectures, readings, discussions, and individual reports. Thirty hours.

836. **ENGLISH HISTORY.** This course affords a rapid survey of the whole field of English history, laying special emphasis upon the more important periods and movements. Lectures, discussions, readings, and reports. Thirty hours.

837. **MEDIAEVAL AND MODERN HISTORY.** A study of the principal movements of European history from the fall of the Western Empire through the Napoleonic wars. Such themes as Charlemagne, the Church and the Empire, the Crusades, the City Republics, the Renaissance, the Thirty Years' War are typical subjects. Lectures, discussions, readings, and reports. Forty-five hours.

LATIN

838. ELEMENTARY LATIN. A course in elementary Latin for mature students desiring to gain a knowledge of the fundamentals of the language and to pursue the study of the authors usually read in college preparation. The Roman pronunciation is employed. Thirty hours.

839. COLLEGE LATIN. An advanced course in the reading of Latin authors usually studied during the first years of college work—Cicero, Livy, and Horace. Thirty hours.

MATHEMATICS

840 [321]. TRIGONOMETRY. Study of the trigonometric functions, application to the solution of triangles and to problems in surveying, angular measurement, circular functions. Twenty two-hour sessions, first semester.

841 [322]. ALGEBRA. A secondary course, including a review of quadratic equations, ratio and proportion, variation, progressions, binomial theorem, series, undetermined coefficients, elements of determinants, elements of the theory of algebraic equations, complex quantities. Twenty two-hour sessions, first semester.

842. ANALYTICAL GEOMETRY. Relation between function and variable in Cartesian and polar co-ordinates. Tracing of loci. Transformation of co-ordinates. Properties of the straight

line, circle, and the conic sections. Problems and exercises particularly of the harmonic curves. Brief review of the geometry of three dimensions. Twenty two-hour sessions, second semester.

843 [327]. DESCRIPTIVE GEOMETRY. A course involving the solution in the drafting room of problems on the point, line, and plane, single curved, double curved, and warped surfaces; intersections, tangencies, and developments, orthographic projections, and the elements of perspective. Twenty two-hour sessions, second semester.

844 [325]. DIFFERENTIAL CALCULUS. Development of the derivative. Its interpretation as the equivalent of the slope of a plane curve and as the measure of a variable rate. Elementary rules of differentiation. Theory of the singular points of plane curves and curve tracing. Maxima and minima. Theorems of the mean value and their applications to theory of approximations and developments into series. Designed to meet the requirements of engineers. Twenty two-hour sessions, first semester.

845 [326]. INTEGRAL CALCULUS. The integral as the inverse of the differential and as the limit of the sum of an infinite series of infinitesimals. Definite integrals. Applications to the determination of areas, lengths of curves, volumes, centers of gravity. Moments of inertia. This course is a

continuation of the course next preceding, in which elementary integration is considered and simple applications to mechanics are discussed. Designed to meet the requirements of engineers. Twenty two-hour sessions, second semester.

846 [328]. ANALYTICAL MECHANICS. A course designed to treat problems in mechanics with special reference to the mathematical difficulties involved. This course should be mastered as a preliminary to the study of applied mechanics, to be taken up in the several engineering courses. Statics, kinematics, and kinetics are severally treated. Statics includes the composition and resolution of forces, application to rigid bodies, centres of gravity, friction, virtual velocities, the simple machines, the funicular polygon, the catenary and uniformly loaded chords. Kinematics includes: rectilinear and curvilinear motion, theory of projectiles, trajectories, angular velocities, and accelerations. Kinetics includes: laws of motion, variable forces, resisting medium, central forces, constrained motion, impact, energy, work, dynamics of the steam engine, moments of inertia, rotary motion, the pendulum, simple and compound, and the motion of a system of rigid bodies in space. Double course of forty two-hour sessions, both semesters.

847 [329]. DIFFERENTIAL EQUATIONS. This course is designed to meet the needs of electrical

engineers and mathematical physicists, and not as a systematic study of differential equations. To this end the physical meaning of the first and second derivations is emphasized, and simple equations are employed to illustrate the highly generalized properties of the functions involved in the equation. The use of Professor Byerly's key to the solution of differential equations is then considered. The theory of the potential function is next investigated and Laplace's equation developed. Attention is given in particular to Lagrange's equation, developed as the equivalent of the transverse vibrations of a stretched string, or the transmission of sound waves. This is the starting point of Professor Pupin's investigations on wave propagation over non-uniform electrical conductors. The study of Fourier's series and their application to problems in the flow of heat and equi-potential surfaces are closely related investigations. Twenty two-hour sessions, second semester.

848 [330]. LEAST SQUARES. A brief course involving the study of the probability curve, probable error, and mean error, and the method of least squares so far as to enable the student successfully to solve problems presented in the larger surveys and extended researches in astronomy and mathematical physics. Twenty two-hour sessions, second semester.

849 [335]. CALCULUS OF FINITE DIFFERENCES. A course proposed in the interest of students of actuarial problems. Actuaries and students of life insurance in this city are requested to confer with the instructor as to the needs of students on this subject, with a view to meeting the requirements of the examinations for actuaries. Twenty two-hour sessions.

NATURAL HISTORY

850. BIOLOGY. A course intended for the teacher and the general student, embracing a study of biological technique, equipment and course-outlines, together with the main facts of the science. Twenty hours.

PHILOSOPHY

851 [410]. LOGIC. A study of the formation and uses of concepts and judgments in the syllogism, together with a discussion of fallacies, and practical exercises in deductive and inductive logic. Thirty hours.

852 [411]. PSYCHOLOGY. General outlines of psychology beginning with a study of physiological processes, and proceeding to a consideration of the laws of mind itself in the psychology of sensation, knowledge, feeling, and will. Forty-five hours.

853 [412]. EDUCATIONAL PSYCHOLOGY. A course involving the study of mental development

in the child and the race, and presenting an application of the principles of psychology to efficient teaching. Thirty hours.

854 [413]. ETHICS. A study of the types of ethical theory in the order of their historical unfolding, and of the fundamental problems of human conduct, the rights and duties of man. Forty-five hours.

855. HISTORY OF PHILOSOPHY. A rapid survey of philosophical thought in ancient and modern times. The study of Greek systems, with especial emphasis on Plato and Aristotle, and of mediæval church philosophy, will precede the consideration of Continental rationalism from Descartes, and of English empiricism from Bacon and Hobbes, extending through the critical method of Kant and his successors. Thirty hours.

POLITICAL AND SOCIAL SCIENCE

856 [450]. POLITICAL ECONOMY. The elements of economics, followed by a study of its theory and history, with particular attention to the economic development of the United States, and such problems as the trusts and the relations of capital and labor. Thirty hours.

857. SOCIAL THEORIES AND CONDITIONS. A study of the principles underlying the evolution of society, together with a consideration of past,

present, and ideal societies and of the practical social problems found in modern city life. Thirty hours.

SPANISH

858 [470]. ELEMENTARY SPANISH. A course involving a study of the outlines of Spanish grammar, practice in writing Spanish, the translation of narrative and descriptive prose, together with considerable conversational drill. Thirty hours.

Requirements for Admission

Admission on Examination

Specially qualified candidates for admission to the College may be entered at any time upon special examination; but regular candidates for entrance to the Freshman Class, except as specified below, must present themselves for examination at the College in Brooklyn, on the Monday and Tuesday before Commencement, June 10 and 11, 1907; or on the Wednesday, Thursday and Friday, at the opening of the Fall Semester, September 18, 19 and 20, 1907; or on the Wednesday, Thursday, and Friday prior to the opening of the second semester, February 5, 6, and 7, 1908.

Such candidates, as at the June or September examinations may not be prepared to submit themselves upon all subjects required, may, if they desire, undergo examination in June or September, upon those subjects upon which they are prepared, and upon the remainder in September or February, as the case may be.

PRESCRIBED SUBJECTS

The subjects of examination for admission to the Freshman Class are divided into two groups, prescribed and elective; and to each subject is assigned a certain number of units as determining its relative importance.

The following group of prescribed studies candidates for the Courses in Chemistry and Engineering must present :

English, 4, Modern Languages, 4,
Elementary and Advanced Algebra, 3,
History, 2, Plane and Solid Geometry, 3,
comprising a total of sixteen (16) units.

The following group of prescribed studies candidates for the Course in Arts must present :

Elementary Algebra, 2, History, 2,
English, 4, Plane Geometry, 2,
Foreign Languages (ancient or modern), 4,
comprising a total of fourteen (14) units.

The scope of these subjects is defined below.

ENGLISH

ENGLISH will require evidence of a general knowledge of the subject matter of the books here named, and acquaintance with the lives of their authors.

The books prescribed for this part of the examination are as follows :

In 1907, and 1908: Shakespeare's Merchant of Venice and Macbeth; The Sir Roger de Coverley Papers in the Spectator; Irving's Life of Goldsmith; Coleridge's Ancient Mariner; Scott's Ivanhoe and The Lady of the Lake; Tennyson's Gareth and Lynette, Launcelot and

Elaine, and *The Passing of Arthur*; Lowell's *Vision of Sir Launfal*; George Eliot's *Silas Marner*.

It will also require a more careful study of each of the works named below, tested by a written examination upon their subject matter, form, and structure.

The books prescribed for this part of the examination are as follows:

In 1907, and 1908: Shakespeare's *Julius Cæsar*; Milton's *Lycidas*, *Comus*, *L'Allegro*, and *Il Penseroso*; Burke's *Speech on Conciliation with America*; Macaulay's *Essay on Addison and Life of Johnson*.

In this examination the candidate must further give evidence of ability to express himself readily in accordance with the usage of ordinary prose composition. No candidate will be accepted in English whose work is notably deficient in point of spelling, punctuation, the composition of sentences, or their grouping in paragraphs.

FOREIGN LANGUAGES

In FOREIGN LANGUAGES, at least two of the following subjects must be submitted: Elementary Latin, Elementary Greek, Elementary German, Advanced German, Elementary French, and Advanced French.

ELEMENTARY LATIN will require a knowledge of the subject matter, construction, and the formation and inflection of words in the following works: Virgil, six books of the *Æneid*, with the prosody; Cicero, six orations, including the four against Catiline. Besides this, there will be required the translation at sight of passages adapted to the proficiency of candidates who have studied Latin in a systematic course of at least five lessons a week for three years.

ELEMENTARY GREEK will require the translation at sight of simple Attic prose, adapted to the proficiency of candidates who have studied Greek in a systematic course of five lessons a week for two years, and also ability to answer questions on the forms, constructions, and idioms of the language.

ELEMENTARY GERMAN will require (*a*) the translation into English at sight of simple German prose, and (*b*) the translation into German of simple English sentences designed to test the candidate's familiarity with the rudiments of German grammar. Candidates must have read at least two hundred pages of easy German.

ADVANCED GERMAN will require (*a*) the translation into German of a connected passage of English prose, and at discretion the determination of proficiency in German grammar by direct

questioning; and (b) the translation into English at sight of ordinary German. Candidates must have read at least five hundred pages of classical and contemporary prose and verse from such books as Lessing's *Minna von Barnhelm*; Schiller's *Wilhelm Tell*, *Der dreissigjährige Krieg*, *Maria Stuart*, and *Die Jungfrau von Orleans*; Freytag's *Die Journalisten*; Kohlrausch's *Das Jahr 1813*; and Goethe's *Hermann und Dorothea*, *Egmont*, and *Iphigenie*.

The requirements of **ELEMENTARY FRENCH** will correspond to those of elementary German, except that in this case the reading of four hundred pages of easy French will be presupposed.

ADVANCED FRENCH will correspond in its requirements to advanced German, except that in this case the reading of six hundred pages of classical and contemporary prose and verse will be presupposed.

HISTORY

IN **HISTORY**, two of the following subjects will be required:

(a) The history of Greece to the death of Alexander, with due reference to Greek life, literature, and art.

(b) The history of Rome to the accession of Commodus, with due reference to literature and government.

(c) English history, with due reference to social and political development.

(d) American history, with the elements of Civil Government.

MATHEMATICS

ELEMENTARY ALGEBRA will require a knowledge of the subject through quadratics and progressions.

ADVANCED ALGEBRA will require a knowledge of variation, proportion, inequalities, and incommensurable numbers; the binomial theorem for positive, negative, and fractional exponents; arithmetical and geometrical progressions; the theory and use of logarithms; permutations, combinations, and probabilities; and the theorem of undetermined coefficient.

PLANE GEOMETRY will include in its requirements ability to solve simple original exercises.

SOLID GEOMETRY will require a knowledge of the properties of straight lines and planes, of dihedral and polyedral angles, of projections, of polyhedrons, including prisms, pyramids, and the regular solids, of cylinders, cones, and spheres, of spherical triangles, and the measurement of surfaces and solids.

ELECTIVE SUBJECTS

The above subjects furnish for candidates for the Courses in Chemistry and Engineering sixteen (16) points or units of the total twenty (20) to be required, and there must be chosen, from the following elective groups, subjects aggregating four (4) points to complete the twenty :

Physics, 2,	Chemistry, 2,
Botany, 1,	Zoölogy, 1,
Elementary Latin, 3,	Elementary Greek, 3,
Physiography, 1,	Modern Languages, 4,
Physiology and Hygiene, 1.	

The above subjects furnish for candidates for the Course in Arts fourteen (14) points or units of the total twenty (20) to be required, and there must be chosen, from the following elective groups, subjects aggregating six (6) points to complete the twenty :

Physics, 2,	Elementary Greek, 3,
Botany, 1,	Elementary Latin, 3,
Chemistry, 2,	Advanced Algebra, 1,
Zoölogy, 1,	Solid Geometry, 1,
Physiography, 1,	Modern Languages, 4,
Physiology and Hygiene, 1.	

The scope of these subjects is defined below.

PHYSICS

PHYSICS will require a knowledge of the elementary facts and principles of the subject, together with evidence in a laboratory note-book of quantitative work performed to the extent of thirty-five (35) experiments. Hall & Bergen's text-book or its equivalent.

CHEMISTRY

CHEMISTRY will require evidence in a laboratory note-book of at least fifty (50) experiments performed, and a knowledge of such matter as is contained in Remsen's Introduction to the Study of Chemistry or its equivalent. A laboratory examination must be undergone both in Chemistry and in Physics.

BOTANY

BOTANY will require a knowledge of the general laws and fundamental principles of plant nutrition, assimilation, growth, etc., as exemplified by plants chosen from the different groups, as well as the general comparative morphology, and the broader relationship of plants. A supplementary laboratory examination may be required at discretion.

ZÖÖLOGY

ZÖÖLOGY will require the equivalent of a course of five hours a week for one half-year, and the

presentation of a laboratory note-book. The laboratory practice should have included a study of at least thirteen of the forms named in the following list: amoeba, paramoecium, hydra, sea-anemone, star-fish, sea-urchin, earthworm, crayfish, lobster, spider, millipede, centipede, locust (grass-hopper), dragon-fly, squash-bug, butterfly, bumble-bee, clam, snail, and squid.

PHYSIOLOGY

PHYSIOLOGY AND HYGIENE will require a knowledge of the facts and principles contained in Martin's *The Human Body* (Briefer Course) or its equivalent.

PHYSIOGRAPHY

PHYSIOGRAPHY will require a knowledge of physical geography, such as is contained in Tarr's *Physiography* or its equivalent.

FOREIGN LANGUAGES

ELEMENTARY LATIN and ELEMENTARY GREEK will require a knowledge of the subjects as above defined, but may be submitted only in case they have not been presented by the candidate in his selection from the first group.

MODERN LANGUAGES will imply Elementary German or Advanced German, Elementary French or Advanced French, not submitted by the candidate in his selection from the first group.

Admission on Certificate

Certificates of proficiency are accepted in lieu of examination from students of the Polytechnic Preparatory School, the Public High Schools of Brooklyn and Manhattan, and other accredited institutions. Such certificates must be signed by the Principal of the school from which the candidate comes. Regents' certificates or pass cards are accepted for the ground they cover, and graduates of public schools of the City of New York are exempt from examination upon so much of the elementary studies as is covered by the prescribed courses of the first three years of the Polytechnic Preparatory School.

Admission by certificate allows a student to enter the College conditioned upon his proving himself able to do the full work of his class; at any time during the Freshman year he may be dropped from the class in case his work is not satisfactory.

Admission With Conditions

Candidates are recommended to present themselves for examination in June, so that they may have an opportunity to remove in September any conditions then received. But those who remain conditioned after the September examinations or receive conditions at that time will be admitted,

provided such conditions do not exceed a total of six points in the scale of value for entrance subjects.

It is understood, however, that entrance conditions must be removed before the beginning of the Sophomore year.

Admission to Advanced Standing

Candidates for admission to advanced standing are examined in the subjects required for admission as well as in the subjects which have been pursued by the class they wish to enter.

Students from other institutions of higher education of acknowledged rank will be credited with the work for which they bring the record of full standing in their letters of transfer.

Admission to Courses for Teachers

The conditions for admission to the afternoon, evening, and Saturday Courses for Teachers are set forth in full for convenience of reference under the caption, Courses for Teachers, at page 78.

Special Students

Students who desire to attend lectures and recitations in particular departments only, or to pursue laboratory investigation, may have that privilege, upon giving evidence that they are fully

prepared to enter upon the studies of such departments, and possess so much general training as may entitle them to undertake collegiate work. Students enrolled in regular classes who fail in one or more studies are not allowed to become special students, but are required to make up the studies in which they are deficient.

General Information

Administration

PRESIDENT.—The executive administration of the Polytechnic Institute of Brooklyn is vested in the President. He is the official medium of communication between it and its patrons, and upon him rests the general responsibility for its direction.

FACULTY.—The President and the Professors in responsible charge of the various departments constitute the Faculty, to which is intrusted the direction of all matters of instruction and discipline. The decisions of the Faculty in all matters of scholarship and discipline are final.

The immediate supervision of each department of instruction is assigned to the Professor at its head, aided by as many assistants as the number of students requires.

REGISTRAR.—The Registrar has the general direction of the College routine, with a special oversight of the attendance and the work of the students. He has responsible charge of the scholarship records, from which is determined the standing of students in the College, and which are preserved among the permanent records of the institution.

Library

Upon the main floor of the College Building is the Uriah D. Spicer Memorial Library—the gift of the late Captain Elihu Spicer, in memory of his son, a member of the class of '73.

This Library, of some 10,000 volumes, is designed for general reference and study in all departments of the College work. It embraces general literature, and English, German, and French works on Pure and Applied Sciences, Philosophy, and the Arts. It has been carefully selected and arranged with reference to the various departments of study and investigation. Provision is made for additions in order to keep abreast with the most recent thought. The reading-room is supplied with the leading American and foreign reviews and periodicals of science, art, and general literature, and is open for the free use of students throughout term time. Under the direction and advice of the professors, the Library is made a valuable aid to the several departments of instruction.

Studio

The Studio for the various classes in Art—industrial, technical, and picturesque—is a spacious and well-lighted room, amply supplied with studies and designs from the flat, in relief, and in plaster models. It is open at all times during

sessions for the use of students, and on Saturday mornings for optional and special work. It is under the general direction of the Professor of Drawing and Design.

Observatory and Collections

The Observatory is provided with an equatorial telescope and auxiliary astronomical apparatus.

In the department of Civil Engineering, the College possesses a large collection of rods, compasses, levels, transits, aneroids, and sextants for the field exercises of the department.

In the Museum, upon the main floor, are carefully prepared collections in Geology, Zoölogy, and Paleontology, selected and arranged with special reference to their use in illustrating the class-work and lectures, and in familiarizing the students with fundamental forms and types.

Laboratories

CHEMICAL.—The Chemical Laboratories are large and well-lighted, their ceilings are high, and their ventilation is excellent. Individual desks for students are provided with drawers and lockers, and are supplied with gas, water, and a full set of reagents. In the General Qualitative Laboratory are large hoods with perfect draught for work upon noxious gases. The Quantitative Laboratory is similarly equipped; and each of the Chemical Lecture Rooms is fur-

nished with gas, water, electricity, hoods, pneumatic troughs, and every facility for experimental work. Water analysis is carried on in a special laboratory equipped with the most modern facilities for the chemical, physical, and bacteriological examination of water.

PHYSICAL.—The Physical Laboratory is a large room, equipped with tables, supplied with gas and electricity, and special apparatus for performing about one hundred quantitative physical measurements. At one end of the laboratory there is a light-proof photometer room supplied with a Reichsanstalt form of photometer, having a Lummer-Brodhun contrast-prism screen.

ELECTRICAL.—The Electrical Laboratory, in which the electrical measurements of precision are carried on, is a well-lighted room furnished with electricity from the Edison street service, and equipped with a large number of standards of resistance, and of electro-motive force, together with standard rheostats, galvanometers, and other apparatus to be found in a thoroughly appointed laboratory.

TELEPHONE.—The Telephone equipment consists of a hundred-drop exchange switchboard, connected up through an intermediate and main distributing rack. The latter is supplied with heat coils and lightning arresters. Various forms of subscribers' instruments are mounted in adja-

cent rooms, and are connected with the switchboard.

DYNAMO.—The Dynamo Laboratory is supplied with motors, series, shunt and compound direct current generators, alternators, transformers, a three-phase generator, three-phase motors, and double-current generators. There are also two 30-horse power railroad motors connected up to two K-type car controllers. A switchboard, with over one hundred terminals, connects with the different pieces of apparatus. It is supplied with voltmeters and ammeters, and these are supplemented by portable ammeters, voltmeters, wattmeters, tachometers, and dynamometers.

ENGINEERING.—The Engineering Laboratory is furnished with a Fairbanks cement tester and a Riehle thirty thousand pound testing machine, supplied with the necessary auxiliaries, machines for the testing of lubricity, viscosimeters, and other apparatus for the testing of lubricants, transmission and absorption dynamometers, belt testing apparatus, and machines for the testing of blowers.

HYDRAULIC.—The Hydraulic Laboratory is installed in the basement of the building. It contains a Worthington pump and a capacious tank for maintaining any constant pressure head up to a limit of three hundred pounds per square inch and a complete system of receivers, dams, gauges,

water meters, and platform scales, with a variety of adjustable nozzles, notches, and orifices.

STEAM.—The Steam Laboratory is equipped with a Worthington water-tube boiler, pumps, feed-water heaters, and injectors. Together with an engine, it is used by the students in their exercises for the setting of valves, taking of indicator cards, determination of steam consumption, and practice in the determination of efficiencies. A duplex two-cycle gas engine will be completed for the laboratory by students and installed before June, 1905. The laboratory contains an air-compressor constructed by students, a high-speed, internal-combustion kerosene oil engine, a Rider hot-air pumping engine, a complete outfit of calorimeters, traps, gauges, injectors, vacuum gauges, and indicator springs, for testing steam, as well as calorimeters for determining the calorific value of fuels.

Shops

The carpentry and pattern shop is equipped with benches and wood-turning lathes, and band and circular saws. A set of tools is provided for each bench and lathe, while several sets for a variety of work are kept for use as occasion may require.

The forge-shop contains a number of forges and anvils, with the necessary hammers of graded

weights, sledges, tongs, fullers, swedges, hot and cold chisels, heading tools, and a steam hammer.

The filing bench is fitted with machinists' vises, cold chisels of various shapes and sizes, and hammers of graded weights.

The machine shop contains a 14-inch Putnam engine lathe, two 10-inch Star engine lathes, a Wilkinson planer, a 15-inch shaper, a Sibley and Ware upright drill, a Cincinnati universal milling machine with dividing head and gear cutting attachments, a Cincinnati grinding machine, a power back saw, two emery grinding wheels, and the necessary tools, gauges, micrometers, scales, drills, taps, and reamers. Each student is required to keep a record upon time cards of all piece work.

Gymnasium

On the ground floor, with an area of one hundred feet by seventy, is the Gymnasium. This is equipped with the best appliances for thorough physical exercise and development; with running track, baths, swimming pool, toilet rooms, and lockers, and is under the supervision of a trained director. Use of the Gymnasium is free, under prescribed conditions, to all under-graduates. Instruction in swimming is given to students who desire it. The Athletic Association, a student organization for the furtherance of athletic sports, maintains the usual teams and conducts the annual indoor games.

The Chemical Society

The Polytechnic Chemical Society offers membership to all students in the Chemical Course. At the meetings of the society papers prepared by the students are presented and discussed, and bi-weekly excursions under the personal direction of the Professors are made to the manufactories of New York and adjacent cities for the inspection of chemical processes.

The Engineering Society

The Polytechnic Engineering Society, organized to further knowledge in the several branches of engineering, is composed of students of the Engineering Courses in the College. Reviews of the leading engineering periodicals and dissertations on engineering methods are read at the meetings, and a series of bi-weekly excursions for the inspection of foundries, factories, and plants of interest to the Engineer are conducted through the season. A comprehensive illustrated annual, containing a record of the work done, is published by the Society.

The Mermaid Club

The Mermaid Club is an organization of Juniors, Seniors, and Graduate Students designed to further interest in literature and original composition and to promote the social life of the student body. At bi-weekly meetings topics

of general or literary moment are considered, and such original work as may be presented by the members is discussed.

The Dramatic Association

In the spring of each year the Polytechnic Dramatic Association presents in one of the larger theatres of the city some modern comedy, the cast and entire management being provided by the students. This production affords excellent opportunity for the cultivation of dramatic talent, and is an important social feature of the college life.

Student interests centre also in the usual Greek letter fraternities, the College paper, the Junior Annual, the Senior Mid Winter Ball, and the Junior Promenade.

Students' Expenses

A low estimate of necessary expenses for students upon regular day courses in the College for the Academic year of about thirty-eight weeks may be itemized as follows:

ITEMS.	COURSE IN ARTS.	COURSES IN ENGINEERING.
Tuition	\$150.00	\$200.00
Books	20.00	25.00
Board, 38 Weeks (at \$5 per Week).....	190.00	190.00
Laundry	25.00	25.00
Total	\$385.00	\$440.00

Clothing, carfare, and incidental expenses vary so much with the individual that this estimate

can best be made by each student for himself. The expense for board may be somewhat reduced by taking meals in a students' club. It will be found difficult, however, to reduce the total expense much below \$450 for the Arts Student, and \$500 for the Chemical or Engineering Student. Of course, expenses of board and lodging, clothing and laundry, must be incurred whether one is at college or not.

The material or apparatus which is broken or otherwise damaged during work in the laboratories or shops is paid for by the student. This item, depending upon the character of work and the care bestowed, varies from \$5 to \$20 per year for students of Chemistry and Engineering.

Aid to Students

A Committee on Student Aid, including representatives of the Faculty, the Alumni, and the Corporation, is organized to assist students of limited means to earn their way through college. It seeks to do this, first, by helping students who are willing and able to work to find suitable employment, and, secondly, by recommending deserving students of high rank for such scholarships and other pecuniary assistance as may be available. The Committee will gladly advise with any student regarding the best conditions for economical living, and especially will assist in securing suitable board and lodging at moderate terms.

Early application for employment, scholarships, and rooms, stating as fully as possible the applicant's qualifications, should be made to Professor J. C. Olsen, College of Arts and Engineering, Polytechnic Institute, Brooklyn. Upon request he will furnish blanks for this purpose, and a pamphlet containing suggestions to self-supporting students issued by the Committee.

Regulations

College Year

The College year is divided into semesters; the first beginning fourteen weeks after Commencement and ending on the first Monday in February; and the second beginning on the first Monday in February and ending at Commencement. Commencement occurs annually on the Wednesday nearest to June fifteenth. On legal holidays, on Saturdays, on the Friday following Thanksgiving Day, for ten days at Christmas, and for one week at Easter, the exercises of the College are suspended.

Chapel

Chapel exercises of a non-sectarian nature are held at stated intervals. Aside from the religious features, they include addresses upon topics of the time and matters of College interest by members of the Faculty and others. Attendance upon these exercises is required of all students.

Registration

Each student is required to file his schedule of studies at the office of the Registrar within one week after the opening of each semester. If he later wishes to make any change, either in course

or in studies, he must obtain the consent of the President and file such consent with the Registrar.

Status of Students

The status of students in scholarship, their progress in course, and their graduation are determined chiefly by the standing maintained throughout, and by fidelity to stated duties and regularity of attendance. These are supplemented by written examinations and by graduation theses.

Examinations

General examinations are held at the end of January and of May; the January examinations covering the work of the first semester, the May examinations covering that of the second semester and of full year courses.

Intermediate examinations, the results of which are not made a matter of permanent record, are held at any time at the discretion of the instructors.

Students failing to pass upon examination are entitled to a second examination only at the ensuing Fall examination, except in the case of Seniors. Failing to pass this second examination they are required to repeat the subject in class, unless by vote of the Faculty further time be allowed them.

Optional Studies

Students in good standing entered upon any course may pursue studies in any other course subject to the approval of the President. For Scientific students optional studies are especially recommended from those provided by the Arts Course, while for Arts students Scientific subjects present excellent options. In no case, however, are optional studies allowed unless the student's standing in prescribed work is entirely satisfactory to the professors concerned.

Reports of Standing

Semestral reports of the standing of all students are filed with the Registrar, and may be seen on application. In cases of failure to secure the minimum of seventy-five per cent in any subject, reports are sent to parents or guardians.

Theses

Every student, as a necessary portion of the exercises for his final examination for a degree, is required to present a thesis upon some topic connected with the course from which he is to graduate.

The thesis may be either a dissertation upon a subject included in the student's course of study; an account of some original research undertaken by him; an original report upon an engineering work or a machine, or an original design accom-

panied by an explanatory statement in writing. The thesis should be accompanied by drawings and diagrams whenever the subjects need such illustration. It must be typewritten upon paper of good quality, eight and a half by eleven inches in size, with margins of one inch on the inner and one-half inch on the outer edges, and be bound in boards and stamped as follows:

(TITLE OF WORK)

Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of

(NAME OF DEGREE)

in the

College of Arts and Engineering,
Polytechnic Institute of Brooklyn,

by

(NAME OF CANDIDATE)

The thesis must be filed with the Secretary of the Faculty not later than June first of the year in which the degree is to be taken, such copy to be later placed in the Library. A copy must also be filed with and approved by the Department under which the thesis is written.

Degrees

No Student will be recommended by the Faculty for a degree who has not attended the College for at least the year immediately preceding

graduation, and has not satisfactorily completed every subject upon his course, passed creditable examinations, and presented an acceptable dissertation or thesis for graduation.

The degrees awarded by the College are Bachelor of Arts, Bachelor of Science, Chemical Engineer, Electrical Engineer, Civil Engineer, Mechanical Engineer, Master of Arts, and Master of Science. These are granted by the Corporation upon the recommendation of the Faculty, and are conferred at the annual Commencement in June.

Fees

The tuition fees for students entered upon the regular day courses are as follows, one-half payable at the beginning of each semester:

Course in Arts.....	\$150
Courses in Chemistry and Engineering..	200

The fee for special students upon selected or special courses is at the rate of fifteen dollars (\$15) per annum for each hour of lecture or recitation attendance a week—the minimum charge, however, being fifty dollars (\$50), and the maximum two hundred dollars (\$200). Two hours of drawing, shop, or laboratory work are, for this purpose, equivalent to one hour of lecture or recitation. Fees are payable as upon the regular courses.

The fees cover all apparatus, materials, and tools required for use in the machine shops and the physical and mechanical laboratories, as well as all privileges of the gymnasium and baths, full use of the library, and the ordinary charges for matriculation and graduation; but the material or apparatus which is broken or otherwise damaged during work in the laboratories or shops is paid for by the student, bills being rendered at the close of the year. This item, depending upon the character of work and the care bestowed, varies from \$5 to \$20 per year for students of Engineering and Chemistry.

Payment is required in advance, and no reduction is made in case of withdrawal, except in cases of serious and prolonged illness, and then only on application. No student can be withdrawn with remission of tuition charges during the year, except for satisfactory reasons, approved by the President.

For the maintenance of the various undergraduate athletic organizations and teams, each student is asked to contribute \$3 per annum for dues and admission to all games. This is intended to take the place of the various subscription papers usually passed among students and to equalize and limit the amount contributed for these purposes. For convenience and to indicate the approval of the College authorities, this subscription is added to the tuition bill; but it is no

part of the College accounts, and payment of it is optional.

The tuition fees for students of the Course in Pedagogy or any afternoon, evening, or Saturday Extension Course, except courses in technology offered by Consulting Professors, are computed as follows:

For the first 100 hours....	\$.40 per hour
From 100 to 200 hours...	.35 per hour
From 200 to 300 hours...	.30 per hour

The tuition fees for students taking courses in Chemistry or Engineering offered by the Consulting Professors vary in different cases and are announced in special bulletins describing such courses.

Scholarships

The *Henry Ginnel DeWitt* scholarship, value \$200 per annum, founded in memory of a member of the Class of 1884, and the *William Ginnel Simmons* scholarship, of the same value, founded in memory of a member of the Class of 1893, are awarded annually on nomination of the donors and by vote of the Faculty, to students whose character and whose record for excellence of scholarship merit this recognition.

In addition to these, the College offers annually eight scholarships, each of \$100 value, as follows: two to the Polytechnic Preparatory School, two to the Boys' High School, two to

Erasmus Hall High School, and two to the Manual Training High School in the Borough of Brooklyn.

These scholarships are awarded to those students who pass the best examinations for entrance to the Freshman Class of the College, and are recommended by the Principals of the schools from which they come as worthy of the award in respect to character and scholarship.

All scholarships are assigned for one year only, but may be reassigned, in the discretion of the Faculty, for succeeding years. Tenure of a scholarship during one year gives no title, therefore, to the student for its continuance thereafter. Scholarships are deemed honors, and will not be awarded to students manifestly unworthy; and they may be withdrawn during tenure, at the discretion of the Faculty. As they are designed to afford aid to students requiring it, those students not needing assistance should not present themselves as applicants.

To students not requiring such aid, but whose special proficiency is exhibited by excellence of entrance examination, mention with honor will be made in the Annual Catalogue.

Corporation Prizes

Four prizes of twenty-five dollars each are offered by the Corporation for the best essays by members of the Freshmen, Sophomore, Junior, and Senior classes; with the proviso, however, that at least three essays must be submitted from any class to justify the award. The subjects are given by the Faculty, and the awards are made by judges not connected with the College. The prizes are presented at Commencement.

Alfred Raymond Prize

The income of a fund of one thousand dollars, given by Dr. Rossiter W. Raymond, the first graduate of the Polytechnic, in memory of his son, Alfred Raymond, a former student of the College, is awarded annually at Commencement to that member of the Senior Class presenting the best graduating thesis in Civil, Electrical, or Mechanical Engineering.

R. Livingston Fernbach Prizes

Two prizes of twenty-five dollars each are offered annually by R. Livingston Fernbach to students of chemistry in the Polytechnic Institute. One prize is awarded to the student who, after attending the Chemistry Department's tours of inspection to technical plants, shall present in a written thesis the most practical suggestions as to how any process he has seen and

subsequently has studied, may be modified or improved. The other prize is awarded to the student who shall present in a written thesis the most practical plans and suggestions as to the arrangement and equipment of a technical laboratory for any given form of analysis, such a laboratory being calculated to turn out the maximum work in a minimum time, upon a limited appropriation.

Honors

Honors are given at graduation for special work of a high order of excellence done in any department. Such honors will be voted by the Faculty to those students whose graduation theses show exceptional excellence, and who have completed with unusual success courses of study in the departments in which the theses are presented. The thesis must show work additional to all requirements for graduation, equal to two hours per week for one-half year. Students wishing to become candidates for special honors in any department must make application to the Faculty at the opening of the second semester, through the professor in whose department the honors are sought.

Gifts to the Institute, 1906-07

- From William H. Nichols, '68:
\$500,000. Subscribed to the Endowment Fund conditionally.
- From the A. M. White Estate, through William Augustus White, '59:
\$250,000. Subscribed to the Endowment Fund conditionally.
- From George Foster Peabody:
\$50,000. Subscribed to the Endowment Fund conditionally.
- From Frank Lyman:
\$10,000. Subscribed to the Endowment Fund conditionally.
- From Frank Bailey:
\$5,000. Subscribed to the Endowment Fund conditionally.
- From James L. Morgan:
\$5,000. Subscribed to the Endowment Fund conditionally.
- From Frank Jones:
\$5,000. Subscribed to the Endowment Fund conditionally.
- From Standford S. Steele:
\$5,000. Subscribed to the Endowment Fund conditionally.
- From Members of the Board of Trustees:
\$16,500. Subscribed for Current Expenses.
- From C. O. Mailloux, '05:
Projectoscope, L. E. Knott Co.
- From C. E. Potts, '92, '93:
Harmonic Motion of Rotation Wheel,
Inertia Wheel for Acceleration Experiments,
Air Thermometer and Gas Apparatus.
- From William B. Kouwenhoven, '06:
General Electric Company Powerfactor Motor.

- From A. W. Beresford, '92:
6 5 h. p. Motor Starting Boxes, 220-250 volts.
- From Students:
Megalhaes Phasing Transformers,
Buchaca Fluxmeter,
McCarthy and Hewlett Train Testing Apparatus.
- From the Western Electric Company:
Movement for Fluxmeter.
- From the Cooper Hewitt Electric Company:
Mercury Hewitt Converter with Starting Devices.
- From John S. Frothingham, in memory of Nathaniel
Frothingham, '79:
Engineers' Transit.
- From the Lehigh Portland Cement Company:
Cement Making Exhibit.
- From the Concrete Steel Engineering Company:
Engineering Exhibits.
- From the Expanded Metal Engineering Company:
Engineering Exhibits.
- From the John Pierce Company:
Engineering Exhibits.
- From Louis J. Boury, '79:
Equatorial Telescope,
Collection of Casts and Models.
- From the Vacuum Oil Company:
Exhibit of Sample Oils.
- From the Detroit Seamless Steel Tubes Company:
Exhibit of the Detroit Locomotive Flue.
- From Herman A. Metz:
Chemicals to illustrate the Coal Tar Dyes.
- From Herbert Boughton, '05:
2 Volumes for the Spicer Memorial Library.
- From Herbert J. Robinson, '05, In Memory of Charles
K. Robinson:
219 Volumes for the Spicer Memorial Library.

Alumni Association

OF THE

Polytechnic Institute of Brooklyn

The Alumni Association of the Polytechnic includes in its membership all graduates holding degrees from the Polytechnic Institute of Brooklyn, or degrees or certificates from its predecessor, the Brooklyn Collegiate and Polytechnic Institute, as well as all other persons who have at any time been students in either of these institutions.

OFFICERS

- Chairman John Garrett Underhill, '94.
Hotel St. George, Brooklyn.
- Vice-President..... William Augustus White, '59.
158 Columbia Heights, Brooklyn.
- Secretary Alfred Muller, '96.
Brooklyn Savings Bank, Brooklyn.
- Treasurer Oskytel H. Clarke, '02.
Polytechnic Institute, Brooklyn.

BOARD OF MANAGERS.

- | | |
|----------------------------|----------------------------|
| Adams, James T., '98, | Blair, John N., '82, |
| Allen, William L., '76, | Bliss, John L., '75, |
| Allin, George L., '94. | Bonynge, Paul, '95, |
| Atkinson, Fred W. (Pres.), | Boughton, Herbert, '87, |
| Berry, William J., '03, | Brinkerhoff, Alex. G., 73, |

Brower, Edward S., '96,	Maddren, Wm. H., Dr., '96,
Cahoone, Richards M., '90,	Massa, Samuel B., '60,
Childe, Cromwell, '84,	Mason, Hobart, '00,
Chittenden, R. Percy, '87,	Meisel, Albert W., '02,
Cochran, David H., Jr., '89,	Nichols, William H., '68,
Codwise, Edward B., '65,	Parsons, Frank H., '77,
Coughlin, William H., '63,	Peters, Thomas P., '89,
Cromwell, George, '73,	Potts, Charles E., '92,
Dauchy, Fred. W., '77,	Prosser, Frank, '93,
Dorman, William R., '88,	Raymond, Charles W., '61,
Dougherty, Paul, '96.	Raymond, Rossiter W., '58,
Dudley, Wm. F., Dr., '83,	Reeve, Henry W., '63,
Fowler, Russell S., Dr., '91,	Rooney, John J., '92,
Frothingham, Theo. L., '80,	Rushmore, J. D., Dr., '64,
Hamilton, Clayton M., '00,	Russell, Richard L., '93,
Henshaw, Walter P., '98,	Schmitt, Jacob, '99,
Ihlseng, Magnus C., '72,	Snook, Thomas E., '81,
Kimball, Walter C., '90,	Underhill, John G., '94,
Kimball, Richard B., '97,	Walden, Russell, '70,
Lane, Frederick H., '04,	Wheeler, Philip M., '94,
Leberthon, Henry G., '01,	White, Wm. A., '59.

Titles of Graduation Theses

Presented June 1, 1906

The Titration of Tannic Acid by Oxidation with Potassium Bichromate, By William Clinton Bainbridge.

Alizarine and Alizarine Lakes,

By Constant Benoit, B.S.

An Investigation of the Losses in the Positive and Negative Feeders of the Brooklyn Rapid Transit System.

By George Irving Branch, M.E.

A New Type of Fluxmeter, By Emilio José Buchaca.
Lightning and Lightning Protection,

By Roland Speakman Child.

A Study and Proposed Design for the Abolition of the Grade Crossing at the Intersection of New York Ave. and the L. I. R. R. at Jamaica, L. I.,

By Rudolph Evers.

An Investigation of the Losses in the Positive and Negative Feeders of the Brooklyn Rapid Transit System,

By Otto Thomas Gierisch, M.E.

The Production of Unity Power Factor on Long Distance Transmission Lines,

By William Bennett Kouwenhoven.

A Design for a Proposed Extension of the Water Supply for the City of Trinidad, Colorado,

By Frederick Ljung.

The Design of a Steel Highway Bridge,

By Harry Milton Lynde.

- The Constructing and Testing of a Special Time Recorder,
By George M. McCarthy.
- The Design and Construction of a Phasing Transformer,
By Frank Vasconcellos de Magalhaes.
- Train Movement Phenomena,
By Cyprien Odilon Mailloux, E.E.
- A Design for a Proposed Extension of the Water Supply System for the City of Trinidad, Colorado,
By Frederick Chester Nichols, B.S.
- Low Life in the English Drama of the Seventeenth Century,
By Ernest John Streubel, A.B.
- Congo Red and Its Blue Derivative: Aniline and Cadmium Salts,
By Albert Horace Tag.
- Cascade Regulation of Three Phase Motors for Railway Work,
By Frank Nehemiah Waterman, M.E.
- The Beginnings of the Settling of the West,
By William Heber Wilson.

Degrees Granted at the Annual Commencement

June 14, 1906

BACHELOR OF ARTS

William Heber Wilson.

BACHELOR OF SCIENCE IN CHEMISTRY

William Clinton Bainbridge,
Albert Horace Tag.

CIVIL ENGINEER

Rudolph Evers (*Honors in Mathematics*),
Frederick Ljung,
Harry Milton Lynde.

ELECTRICAL ENGINEER

George Irving Branch, M.E.,
Emilio José Buchaca,
Roland Speakman Child (*Honors in Mathematics*),
Otto Thomas Gierisch, M.E.,
William Bennett Kouwenhoven (*Cum Laude*),
George M. McCarthy,
Frank Vasconcellos de Magalhaes.

MECHANICAL ENGINEER

Frederick Chester Nichols, B.S.

MASTER OF ARTS

Ernest John Streubel, A.B.

MASTER OF SCIENCE

Constant Alexander Benoit, B.S.,
Cyprien Odilon Mailloux, E.E.,
Frank Nehemiah Waterman, M.E.

Roster of Students (1906-1907)

GRADUATE STUDENTS

Adler, Alphonse	Brooklyn
B.S., Cooper Union.	
Bersin, Albert	New York
B.S., Cooper Union.	
Bishop, William	Jamaica, L. I.
B.S., Cooper Union.	
Bittman, Walter H.....	Brooklyn
B.S., Cooper Union.	
Brady, Joseph	New York
B.S., Cooper Union.	
Brown, Morris	New York
B.S., Cooper Union.	
Buttendarf, Albert	Brooklyn
B.S., Cooper Union.	
Cahn, Elias,	New York
B.S., Cooper Union.	
Carlson, John A.	Brooklyn
B.S., Cooper Union.	
Child, Roland S.	Brooklyn
E.E., Polytechnic Institute.	
Cohen, Max	New York
A.B., C. C. N. Y.	
Falkinburg, George T.....	Flushing, L. I.
A.B., Colgate University.	
Friedmann, Sidney	New York
B.S., Cooper Union.	
Geduld, Samuel	New York
B.S., Cooper Union.	

- Golden, William G.....New York
B.S., Cooper Union.
- Grabkowitz, Jacob M.....New York
B.S., C. C. N. Y.
- Gremple, Charles W.....New York
B.S., Cooper Union.
- Guise, PhilipBrooklyn
B.S., Cooper Union.
- Helfand, H. E.New York
B.S., Cooper Union.
- Jabureck, Charles J.....New York
B.S., Cooper Union.
- Jaffe, MorrisNew York
B.S., Cooper Union.
- Jaffy, Max A.....New York
B.S., Cooper Union.
- Klepper, PaulL. I. City
B.S., Cooper Union.
- Kochendoerffer, William C.....Brooklyn
B.S., Cooper Union.
- Kouwenhoven, William B.....Brooklyn
E.E., Polytechnic Institute.
- Kramer, HermanNew York
A.B., C. C. N. Y.
- Kunze, WalterNewark, N. J.
B.S., Cooper Union.
- Langguth, J. W.....New York
B.S., Cooper Union.
- Levy, Charles H.....New York
A.B., C. C. N. Y.
- Ludlow, George R.....New York
B.S., Cooper Union.

- Lyons, NorbertNew York
A.B., C. C. N. Y.
- McGronan, Charles J.....New York
B.S., Cooper Union.
- McInenly, Charles W.....Bayonne, N. J.
B.S., Cooper Union.
- Martens, Adolph G.....New York
B.S., Cooper Union.
- Mellert, Frederick H.....New York
B.S., Cooper Union.
- Muller, George J. H.....Brooklyn
B.S., Cooper Union.
- Nordstorm, Emil A.....New York
B.S., Cooper Union.
- Nurick, Henry J.....New York
B.S., Cooper Union.
- O'Meara, Joseph W.....New York
B.S., Cooper Union.
- Owen, JamesBrooklyn
B.S., Cooper Union.
- Rabinowitz, LouisNew York
B.S., Cooper Union.
- Richmond, JulianYonkers, N. Y.
M.E., Columbia University.
- Sabarese, AnthonyNew York
B.S., Cooper Union.
- Sachs, PhilipNew York
B.S., Cooper Union.
- Scheiman, B.New York
B.S., Cooper Union.
- Slade, SamuelNew York
B.S., C. C. N. Y.

Solomon, Charles	New York
A.B., C. C. N. Y.	
Strickler, Charles	New York
B.S., Cooper Union.	
Tag, Albert H.	Brooklyn
B.S., Polytechnic Institute.	
Weber, Herman F.....	New York
B.S., Cooper Union.	
Wieder, Samuel	New York
B.S., C. C. N. Y.	
Wolfson, Joseph	New York
B.S., C. C. N. Y.	
Zinkeisen, Oscar T.....	Brooklyn
A.B., Harvard University.	

SENIOR STUDENTS

Alder, George	Brooklyn
Donniez, Arthur J.....	Brooklyn
Fougera, Edmond, Jr.....	Brooklyn
Hegeman, Andrew S.	Brooklyn
Hope, Robert D.....	Hampton, Va
Lathrop, Edward F., Jr.....	Brooklyn
Mantilla, Jerome F., Jr.....	Brooklyn
Mitchell, Robert H.....	Brooklyn
Preston, Thomas J., Jr.....	Princeton, N. J.
Sartorius, August	Brooklyn
Waentig, Eugene H.....	Brooklyn
Westcott, George W.....	Brooklyn
Wiley, James M.....	Brooklyn

CLASS OFFICERS.

Edward F. Lathrop.....	President
Robert H. Mitchell.....	Vice-President
Jerome F. Mantilla, Jr.	Secretary
Andrew S. Hegeman.....	Treasurer

JUNIOR STUDENTS

Buechner, Carl A.....	Brooklyn
Broadhurst, Philip H.....	Brooklyn
Fenn, Irving H.....	New York City
Hawkins, Merrell	Kokomo, Ind.
Heath, Stephen T., Jr.....	Saratoga Springs
Kern, Oliver S.....	Brooklyn
Laux, Thomas A.....	Brooklyn
Nodell, William L.....	Brooklyn
O'Rourke, James F.....	Brooklyn
Payne, Henry E.....	Brooklyn
Post, Arthur W.....	Westbury, L. I.
Russell, James M.....	Brooklyn
Small, George S., 3rd.....	Brooklyn
Smith, Vinton	Brooklyn
Walker, John	Bombay, India
Weiffenback, John	New York City

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Arthur W. Post.....	Vice-President
Stephen V. Heath.....	Secretary
Carl A. Buechner.....	Treasurer

SOPHOMORE STUDENTS

Baldwin, F. Rhey.....	Brooklyn
Beyer, Barnet J.....	New York City
Carey, Thomas F.....	Brooklyn
Christians, George W.....	Freeport, L. I.
Dellert, Joseph G.....	Brooklyn
Dougherty, James H.....	New York City
Douglass, George W.	Brooklyn
Dressner, Victor D.....	New York City
Ferguson, George	New York City
Fox, Maurice E.....	New York City
Frese, Walter	New York City

Holden, Samuel S.	Brooklyn
Hughes, George A., Jr.	Brooklyn
Hughes, William E.	Newark, N. J.
Kapper, Frederick P.	Brooklyn
Kennedy, John C.	Brooklyn
Kirkham, Henry P.	Brooklyn
Lambert, Conrad	Brooklyn
Leslie, Edward A.	Brooklyn
Levy, Harry	New York City
Longbotham, Frank	Brooklyn
McCreery, J. Harold.	New York City
McNicholl, Robert W.	Brooklyn
Maujer, Robert I.	Brooklyn
Norman, George S.	Brooklyn
Peacock, Chester J.	Brooklyn
Pedersen, Arthur	Brooklyn
Peña, Francisco	Manila, P. I.
Price, Alden S.	New York City
Ramsbotham, Elmer H.	Brooklyn
Randall, Joel E.	Brooklyn
Rauchfuss, Arthur A.	Brooklyn
Redniss, Michael	Moscow, Russia
Ritter, Burr H.	Brooklyn
Samburg, Maurice	Brooklyn
Smith, Harold H.	Brooklyn
Swan, William W.	Navesink, N. J.
Watt, George Y.	New Brighton, S. I.
Widmann, Oscar O.	Brooklyn
Wolin, George H.	Brooklyn
Zimmerli, William F.	Brooklyn

CLASS OFFICERS.

Joseph Dellert	President
George E. Ferguson.	Vice-President
Edward A. Leslie.	Secretary
George A. Hughes, Jr.	Treasurer

FRESHMEN STUDENTS

Allaire, Douglass	Brooklyn
Allen, Edwin G.....	Brooklyn
Anderson, Raymond S.....	Brooklyn
Avery, Walter	Brooklyn
Barish, Saul	New York City
Barrett, Sampson A.....	Saratoga Springs
Belcher, Edwin S.	Brooklyn
Bernstein, Urian	Romny, Russia
Brierley, John K.	Brooklyn
Callaghan, Cornelius	New York City
Coleman, David F.....	Tottenville, S. I.
Cooley, John E.	Brooklyn
Corliss, Frank R.....	Stockbridge, Mass.
Cragin, Horace S.	Brooklyn
Cummings, Samuel G.....	Brentwood, L. I.
Eggers, Alfred C.	Brooklyn
von Egloffstein, Frederick J.....	Brooklyn
Ericson, Edward O.....	Helmetta, N. J.
Evans, Archie E.	Brooklyn
Gianella, Percy	Brooklyn
Goldthwaite, Richard S.....	New York City
Griffin, Edwin F.....	Oyster Bay, L. I.
Grunewald, Alfred	Brooklyn
Harper, Cortlandt	Brooklyn
Herzig, Solon	New York City
Hildalgo, Clemente.....	Manila, P. I.
Hoeft, George E.....	Richmond Hill, L. I.
Kerins, John S.....	New York City
King, Benjamin	New London, Ct.
Krafft, Walter H.	Brooklyn
Lees, William T.	Brooklyn
Lewis, Charles H.	Brooklyn
Lindholm, Francis E.....	Princes Bay, S. I.
Martin, John B.....	Brentwood, L. I.

Meyer, William E.....	Belleville, N. J.
Monat, Louis	Brooklyn
Moore, William E. W.....	Brooklyn
Morgenstern, Otto	Brooklyn
Mulhearn, Lawrence J.....	New York City
Muncie, Curtis H.	Brooklyn
Osterhout, William E.	Brooklyn
Peckham, Henry D.	Brooklyn
Powers, Louis	Central Park, L. I.
Ross, James D.	Brooklyn
Sartorius, Herman W.	Brooklyn
Saunderson, Frank W.....	Lawrence, L. I.
Schaefer, Ernest L.	Brooklyn
Schmitt, Edgar W.	Brooklyn
Simon, Abram	Brooklyn
Steiner, Jesse	Brooklyn
Swanstrom, Arthur M.....	Brooklyn
Taylor, Allen L.	Brooklyn
Tuthill, Harry H.	Brooklyn
Wilkins, George B.....	Richmond Hill, L. I.
Zengerle, Joseph C.	Brooklyn

CLASS OFFICERS.

E. Seymour Belcher.....	President
Raymond S. Anderson.....	Vice-President
J. Dunbar Ross.....	Secretary
Edgar Schmitt	Treasurer

SPECIAL STUDENTS

Brevoort, Carson	Brooklyn
Fackner, Leonard E.	Brooklyn
Fields, John J., 3rd.....	Red Bank, N. J.
France, George P. Jr.....	Olean, N. Y.
Frazer, John C.....	East Islip, L. I.
Hill, Arthur St. J.	Norwalk, Ct.

Schumacher, Albert G.....	Brooklyn
Sweedler, Nathan	Brooklyn

SCHOLARSHIP STUDENTS

Class of 1907.

Edward F. Lathrop	Boys' High
Robert H. Mitchell	Boys' High
James M. Wiley	Erasmus Hall
Robert D. Hope, Jr.	De Witt

Class of 1908.

Oliver S. Kern	Erasmus Hall
Arthur W. Post	Polytechnic Preparatory
James M. Russell	Boys' High
Stephen T. Heath	Simmons

Class of 1909.

Joseph Dellert	Erasmus Hall
Frank Longbotham	Erasmus Hall
Arthur Pederson	Manual Training
Chester J. Peacock	Boys' High

Class of 1910.

John R. Brierly.....	Erasmus Hall
William E. Osterhout.....	Boys' High
Henry D. Peckham.....	Polytechnic Preparatory
Edgar W. Schmitt.....	Polytechnic Preparatory
John E. Cooley.....	Erasmus Hall
Edwin G. Allen.....	Manual Training
Jesse Steiner	Manual Training

AFTERNOON AND EVENING STUDENTS IN ARTS.

Allen, M. E.....	Brooklyn
Allen, Grace	Brooklyn
Anderson, Ida A.....	Brooklyn
Anderson, Mary C.....	Brooklyn
Anderson, Teresa C.	Brooklyn

Arnold, E. F.....	Brooklyn
Ashman, Jennie C.....	Brooklyn
Athey, Frances M.....	Brooklyn
Averill, E.	Brooklyn
Axelstrom, D. E.....	Brooklyn
Baker, Mary J.....	Brooklyn
Bandel, C. F.....	Brooklyn
Barton, Aida N.....	Brooklyn
Bauer, Anna S.....	Brooklyn
Beal, R. C.	Brooklyn
Becker, Johanna S.....	Brooklyn
Behuken, Erna S.	Brooklyn
Beisheim, William F.....	Brooklyn
Bigelow, Finette	Brooklyn
Blumenstein, Anna G.....	Brooklyn
Blumenstock, Jacob	Brooklyn
Blydenburgh, J. E.	Brooklyn
Bohen, Elizabeth M.....	Brooklyn
Bole, John A.	Brooklyn
Bostwick, Sarah W.....	Brooklyn
Boulton, Isabella A.....	Brooklyn
Birdsall, J. Augusta	Brooklyn
Brady, Jane	Brooklyn
Braine, Elizabeth M.....	Brooklyn
Brinckerhoff, Jeanette	Brooklyn
Brigham, Antoinette	Brooklyn
Broman, Freda A.....	Brooklyn
Brombacher, Anne C.....	Brooklyn
Brown, Edith H.....	Brooklyn
Brown, Ida M.....	Brooklyn
Brown, Laura	Brooklyn
Bunte, Lillian	Brooklyn
Campbell, Dorothea	Brooklyn
Campbell, Harold G.....	Brooklyn
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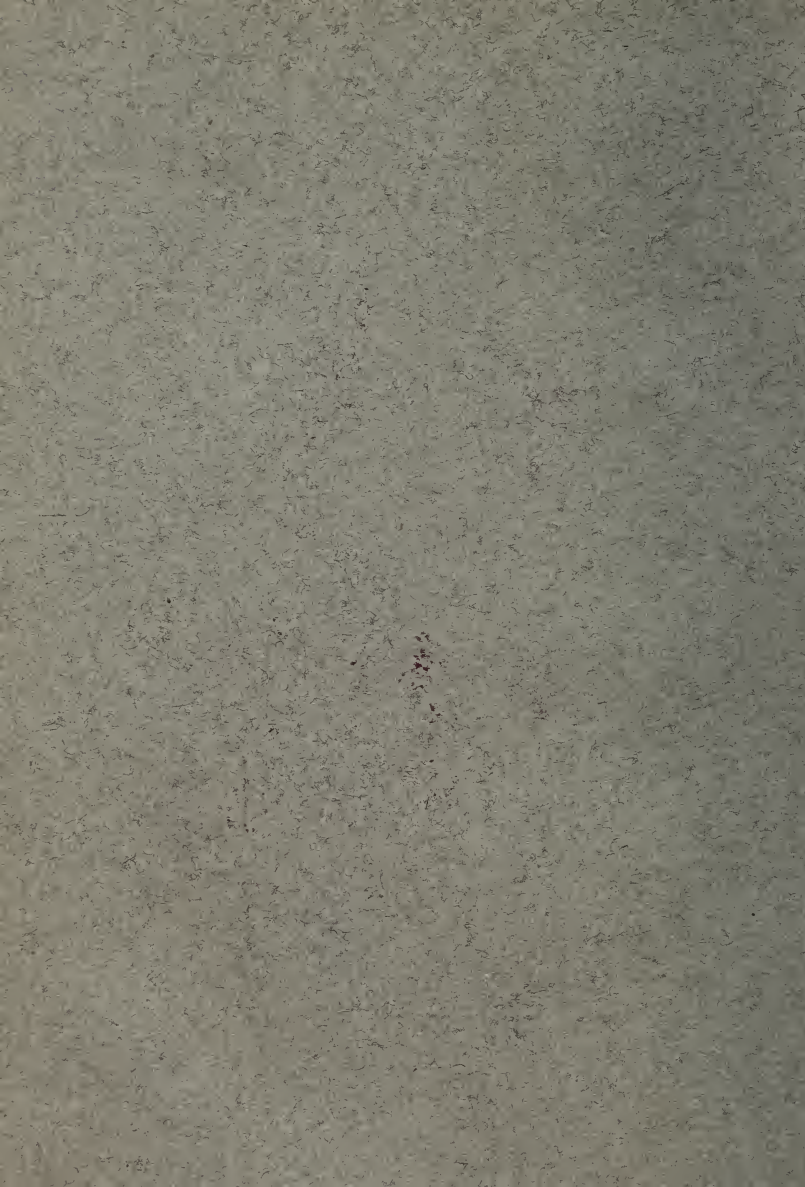
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